WOODS HOLE OCEANOGRAPHIC INSTITUTION

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An Experimental Air-Sea-Rescue Drift Buoy

By

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Throughout the course of development and test of the structural design, valuable assistance has been received from the Hazeltine Electronics Corporation of Little Neck, New York.

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AN EXPERIMENTAL AIR-SEA-RESCUE DRIFT BUOY

Abstract

This report contains information for the manufacture, maintenance, and use of a droppable, emergency radio equipment designed to facilitate the locating of conscious or unconscious survivors of naval aircraft or vessels abandoned at sea. When mechanically or manually launched, this device will automatically transmit keyed, tone-modulated signals on the UHF guard channel of 243 mcs. for a period exceeding 60 hours. These signals can be received at a maximum over-water distance of about 40 miles by an airborne AN/ARC-27 Transmitter-Receiver and homed on by the associated AN/ARA-25 Direction-Finding Adapter.

Equipped with a pneumatic float, the Air-Sea-Rescue Drift Buoy will have under varying conditions of wind and ocean surface current almost exactly the same rate and direction of drift as standard U. S. Navy aircraft rafts when normally loaded and retarded by sea anchor. The buoy, on impact with the water, displays dye marker and a small incandescent light to assist the pilot of a distressed aircraft to ditch near it, and to enable raftsmen to locate the buoy and take it in tow. This unit, weighing 14.5 pounds, may be stowed and ejected by any of the racks accomodating the Listening Sonobuoy AN/SSQ-2. It will function in small or large bodies of fresh water and can be put into operation by survivors of a forced landing ashore.

A photograph of this beacon (Fig. 1) is found on the following page. This shows the equipment in signalling condition after its aerial drop and impact with the sea surface.

Fig. 1 ASR Drift Buoy in operation following its launching from an aircraft at 2000 ft. altitude.

I INTRODUCTION

Earlier WHOI work Air-Sea-Rescue problems

During World War II the Woods Hole Oceanographic Institution, under contract with the Office of Scientific Research and Development, made a detailed study of the drift characteristics of U.S. naval aircraft rafts and prepared the leeway table and certain operational considerations which were incorporated in U.S. Hydrographic Office publication No. 235. This manual, "Methods of Locating Survivors Adrift in Rubber Rafts", though published in 1944, still constitutes the accepted but far from sufficient basis for conducting search for raftsmen.

Following the outbreak of the Korean War the Institution re-surveyed a number of unresolved, critical problems of air-sea search and rescue. And in 1951 with the sponsorship of the Office of Naval Research, under contracts N6onr-277 and Nonr-769(00), it began work on a development to facilitate search. For an understanding of this task and the decisions involved the following paragraphs may be helpful.

Handicaps to present ocean search

Despite the lightweight radio "transceivers" and visual signalling aids which have been provided for survivors of aircraft and surface vessel disasters at sea, the tracking of these men as their emergency craft are borne from the accident site by wind and currents usually presents great difficulties. To

increase the chances of successful ocean search, the experience of World War II has shown that more and better information is commonly needed on the locally existing conditions which are causing the drift of the survivors' rafts or boats. However, since in many ocean areas the varying winds and complex currents cannot as yet be closely predicted and since the obtaining of on-the-spot, frequent, reliable measurements of these forces after a distress is an almost insuperable problem for any Search and Rescue center, it seemed worthwhile to attack the problem of survivors' drift by a simpler, more direct method.

Automatic Radio Buoy

For this purpose the Institution on 15 February 1951 proposed to the Office of Naval Research the development of a small droppable, buoyant, radio beacon which could be regularly carried and at a time of distress launched by any U.S. naval aircraft or vessel. It was considered essential that this buoy be designed to ride out the worst of sea conditions and function automatically as soon as it was sea-borne.

It was proposed that the beacon be equipped to send out alerting and identifying signals which would serve for prompt notification of a distress and the locating of the buoy by aircraft, vessels, or shore stations using radio direction-finding equipment. The incorporation of both a high frequency and a short-wave transmitter was obviously most desirable if their space and weight requirements could be met in a buoy small and

light enough to be acceptable for most types of naval aircraft.

The inclusion of one or more kinds of visual signals for short-range recognition of the buoy on the sea surface was also recommended. Even though they were restricted to a single hour's operation after the buoy's launching, they would afford in many ditching or ship-abandonment situations an adequate opportunity for survivors to locate the buoy, maneuver their craft to it, and take it in tow. In such cases a locating of the buoy would thus be synonymous with a discovery of the survivors.

Desired drift character of buoy

A distinctive feature of the buoy -- a feature of particular value where survivors were incapable of retrieving the buoy and securing it to their emergency craft -- was the designing of the buoy in such a way that when it was freely drifting its rate and direction of drift would be almost exactly the same as that of the survivors' craft when retarded by sea anchor. Thus, even after a much delayed or interrupted search, a locating of the buoy by search craft would bring the searchers within a few miles of the survivors and permit the latter to use their visual signals or emergency transceiver effectively.

O.N.R. Conference on buoy

To obtain constructive criticism of the proposed

development, the Geophysics Branch of the Office of Naval Research arranged for a conference of representatives from various U.S. service organizations concerned with search and rescue operations and equipment. This was held in Washington, D.C. on 19 February 1951. After analysis was made of specific features and problems of the device, the consensus of the meeting was that the Institution should be encouraged to proceed with its work as then outlined.

Exploratory phases of development task

During the following months information was obtained by the Institution on various items of standard or experimental equipment which in one or more respects were of significance to the development task. Several types of radio transmitter buoys for other naval purposes were investigated, and a series of tests was conducted by WHOI to determine the requirements for the drift characteristics desired for the rescue buoy. During the summer of 1951 the possibilities and limitations of various electronic systems were considered, and estimates made of the signal ranges and operating life obtainable with each in terms of given weights and volumes of equipment.

It had become apparent that for acceptability and use by the largest number of naval aircraft in the years immediately ahead, an automatic distress buoy should not exceed 25 lbs. in weight; and that this limit precluded the incorporation of a high frequency and a UHF transmitter or radar responder with a

power supply permitting their effective operation for a minimum of 24 hours.

DCNO (air) requirements for ASR Drift Buoy

At this point it seemed essential that naval authority state the size, weight, ranges, and general operating characteristics of one or more types of distress buoy that would be most desirable. A request for such requirements was submitted via the Chief of Naval Research to the Chief of Naval Operations on 30 August 1951.

Enclosed with this request was an outline of the electronic characteristics and mechanical features of two weights and sizes of sea beacons which appeared realistic and obtainable with a UHF transmitter only. These were equipments which in pre-launched condition were to have the descent-retarding cap, general configuration, and external diameter of the Listening Sonobuoy AN/SSQ-2, with over-all lengths of 21.5 and 36 inches respectively. Such beacons could thus be launched from any of the standard ejectors installed on U.S. Navy aircraft for this sonobuoy.

The upper weight limits suggested for these two beacon models were 12.6 and 20.8 pounds. To assure effective signal propagation under all conditions of use, it was recommended that each model be designed to have positive buoyancy even if its pneumatic float were not inflated. While it was correctly assumed that the operating life and typical transmitting ranges of either model could be a considerable improvement over the

possibilities of the emergency transceiver AN/CRC-7 then issued with naval life-rafts, the transmissions would, however, be limited to line-of-sight distances.

On 25 October 1951 requirements, written by the Military Requirements and Development Branch, Air Warfare Division, DCNO (Air), were issued by the Chief of Naval Operations. These were concerned with short-wave radio transmission only and the development of distress beacons of the approximate weights and sizes suggested by the Institution. While patrol planes, transports, and training aircraft could be equipped with a successful device of this type, DCNO (Air) did not consider it practical to carry such a buoy in high-performance, carrier-based aircraft. The use of sonobuoy ejectors was approved. Signal life for 48 hours was desired, but considered not so essential as maximum range.

One general requirement not contemplated by Woods Hole for this type of naval buoy was that it should "operate on land or water". This implied automatic erection and stabilization of the beacon on any type of terrain and would involve mechanical provisions with weight-volume penalties greatly exceeding those necessary for its marine use. However, it was later stated by DCNO (Air) that land operation was not held to be of primary importance, but that the requirement had been included to stimulate exploration of any means which might make this attainable along with good sea performance.

The drift performance (and pneumatic equipment) suggested by WHOI for the buoy had not been originally understood

by DCNO (Air), but when later discussed was regarded as a unique, valuable feature.

In view of the foregoing considerations, it was concluded that for the first equipment to be developed by the Institution an emphasis could probably best be given to the following:

1) larger model of buoy (external dimensions of 36" x 4 7/8" diameter -- dimensions identical with those of Sonobuoy AN/SSQ-2 -- with weight not exceeding 20.8 lbs.)
2) buoy designed for sea operation only
3) buoy incorporating one transmitter only -- a UHF instrument designed to operate on 243 megacycles and to be received and homed on by the airborne equipments AN/ARC-27 and AN/ARA-25 then in production
4) maximum signal range to be sought, with operating life a lesser consideration.

This program was subsequently approved by the Office of Naval Research and became the basis for the Institution's contractual work.

II STRUCTURAL AND MECHANICAL DESIGN

General Description

From a functional standpoint, the basic components of the ASR Drift Buoy design are:

a) the UHF transmitter

b) the drift-float

c) the case and the auxiliary mechanisms which limit the terminal air speed and set the buoy into operating condition after impact with the sea.

These components are incorporated in a structural design which permits the use of existing stowing and launching equipment.

The ASR Drift Buoy, in prelaunched condition, as shown in Figure 2, has the same external dimensions as the AN/SSQ-2 sonobuoy and utilizes the same "mechanical parachute", impact plate assembly and dye-markers. This similarity to the sonobuoy is retained during launching, air drop and impact. The operations which are initiated by impact jettison the "mechanical parachute" cap and rotor assembly, the float-cover sections and the impact and dye-marker plates. They also close transmitter switches and start float inflation, thereby rendering the buoy capable of performing its basic functions. In construction the buoy consists of an upper and a lower case joined with gasketed flanges. The smaller upper case contains the shock-mounted transmitter chassis, switches, release mechanism and gas manifold. As shown in Figure 3, the drift-float is mounted around the upper case and when collapsed, is contained in the annular space between case and three-piece cylindrical shield formed by the jettisonable

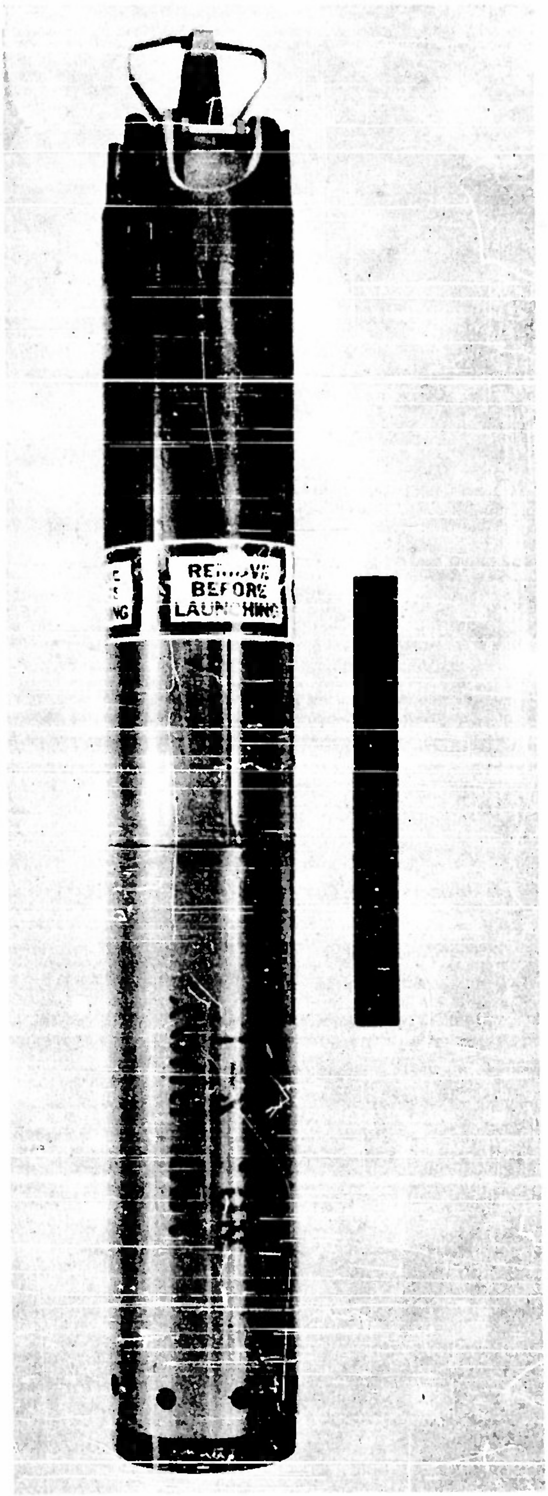

Fig. 2 Initial model (X-1) of ASR Drift Buoy in pre-launched condition.

Fig. 3 Initial model (X-1) of ASR Drift Buoy in operating condition.

cover sections. Batteries and acetylene generator, which are the relatively heavy components, are located in the lower case and so supported that inertia forces are transmitted directly to the base ring, rather than indirectly via the cylindrical portion of the case. The base ring and jettisonable dye-marker plate and impact plate are AN/SSQ-2 sonobuoy parts used with minor modifications. From the impact plate a 1/16" diameter rod extends through a straight 3/16" OD aluminum tube to the transmitter switch which is mounted on the lower end of the upper case. Another rod extends similarly from the transmitter switch to the rotor-release mechanism at the upper end of the buoy. An upward displacement of the impact plate, through the corresponding action of these rods, actuates the switch and release.

The acetylene generator is located in a 3½" deep recess in the lower end-piece of the case. The case end thus serves as the outer generator case. The other generator components are mounted on the generator end-plate and are consequently easily accessible. In prelaunched condition the calcium carbide chamber is sealed off from the gas outlet line and the water reservoir. In addition, the water intake of the reservoir is closed by an external cap. This sealed condition is maintained while the dye-marker plate is in position and these passages are opened when the dye-marker plate is jettisoned. The greater part of the heat of reaction is conducted by the fins provided to the sea water below the end plate. The side walls are cooled by conduction to the base ring and circulation of sea water through the base

ring is made possible by providing passageways and outlet holes in the case which may be seen in Figures 2 and 3, located just above the base ring.

Figure 4 shows the first completed ASR Drift Buoy model beside an AN/SSQ-2 sonobuoy and illustrates the similarity in shape and size.

Design determination

The obvious practical advantage of utilizing existing sonobuoy launching equipment and techniques for handling the ASR Drift Buoy was the main factor in determining external physical dimensions. In establishing the external outline of the prelaunched assembly as a replica of an AN/SSQ-2 sonobuoy, the maximum displacement and maximum allowable weight of the rescue buoy in floating condition were also established. From this limit of volume it was necessary to deduct the space required to accomodate the folded drift-float, the inflated size of which was determined by experiment. Within the limits of space and weight thus established, the electronic and mechanical elements were designed by means of considerable adjustment and compromise so that they would perform the necessary functions and meet the conditions of temperature and pressure to which they would be subjected in service.

In general, the necessary mechanical functions include: retarding the air speed, reducing shock of water impact, inflating drift-float and setting transmitter into operation. Since the

Fig. 4 Listening Sonobuoy AN/SSQ-2 and
ASR Drift Buoy (X-1).

weight is limited by case displacement to be something less than that of the sonobuoy, the descent retarding mechanism and the impact-reducing base plates which had been developed for the sonobuoy were used without modification. The method of retaining the descent-retarding mechanism through time of fall and jettisoning at impact was modified somewhat to release also the three case sections which serve as cover-plates for the drift-float. Because of similar weight limitation and impact characteristics the structural parts of the ASR Drift Buoy case were designed to develop as great a strength as corresponding parts of the sonobuoy case.

The fact that containers of compressed gas, having the required capacity and complying with the space and weight limitations, were not available, necessitated the utilization of some means of generating gas for float inflation. The range of temperatures covering probable service conditions excluded the possibility of carrying water or an aqueous solution in an ampule which would be broken to start the reaction. As an alternative some means of admitting the required amount of sea water seemed necessary. Under the latter conditions, the reaction involving the smallest amounts of weight and space of the various reactions investigated was found to be that of calcium carbide and sea water to form acetylene. Proper gas generator design would provide a sealed compartment for the calcium carbide to assure a long "shelf life". Other factors which influenced the acetylene generator design were; (1) the excess of pressure required for

complete inflation over the static pressure developed by the available height of water head from the surface to the generator position, (2) the necessity of dissipating the heat of reaction at a rate that would prevent over heating, (3) provision for service maintenance.

The extent of the range of values possible for impact force under all conditions of release, wind force and sea state is too great for simple determination. In order to take advantage of previous investigation the switching and release mechanisms were designed to function with the same force and amplitude of motion as the rotor release device of the sonobuoy. This requirement included another somewhat unusual one, i.e., that the devices would function with the first one-eighth inch displacement of the impact plate and would permit free motion of the trigger rod beyond that point for at least the full one-half inch possible displacement of the impact plate. Provision for unlimited free motion would eliminate the necessity of constructing tubes and stops strong enough to meet the force developed by reaction against the highest probable momentum of the trigger rods.

In general where AN/SSQ-2 sonobuoy structural and mechanical parts could not be used the design conformed to the facilities of the WHOI instrument shop and to the use of commercially available forms of the materials of construction.

Design details

Case: The buoy case consists of two cylindrical sections with outside diameters of 3 5/8" and 4 13/16" respectively. Both are constructed of linen-reinforced phenolic resin tubing having a wall thickness of 1/16". The upper section, which is 3 5/8" in diameter, is fitted with an external bakelite sleeve 1¼" long. The outside of this sleeve is machined to take the castellated aluminum collar which serves as the rotor-cap attachment. Collar and sleeve are attached to the case by tubular aluminum rivets. The bakelite sleeve is drilled and tapped to receive the machine screws which hold the top end-plate and machined to take the trigger and spring plunger assembly of the rotor release mechanism. The upper end of the case tubing is flush with the upper face of the ring and consequently takes any downward pressure directly from the end-plate. Such pressures result from the weight and impact loads of the transmitter chassis assembly which is attached, through shock-mounts, to the upper end-plate. To the lower end of the case tube is fitted the sleeve of an aluminum flanged coupling. The sleeve is a light press fit inside the case tubing and the two are fastened with flat-head tubular rivets. The outside diameter of the coupling flange is 1/16" less than the internal diameter of the lower case. The mating member of the coupling consists of a sleeve with an internal flange. This latter sleeve is fitted to the lower case tubing and fastened with rivets. The two members of the coupling are assembled with twelve equally spaced screws which are accessible

when drift-float covers are removed. This coupling provides access to the transmitter power wiring, including impact operated switches, and to the float manifold and fittings as shown in Figure 5. The gas tube and the tube carrying trigger-rods have O-ring sealed slip-joints at this position. It provides access, also, to the battery compartment in the lower case as shown in Figure 6.

The lower case tube extends 1/8" above the assembled coupling flanges and furnishes a retaining ring for the bottom edges of the drift-float covers. Two inches from its lower end the case is riveted to a sleeve fitting which is integral with the acetylene generator housing, Figure 10. The modified AN/SSQ-2 base ring fits inside the extensions of the case tubing beyond the end piece and is attached to the end piece by four screws. This permits assembly of bottom crash plate, dye-marker plate and trigger-foot to the base ring before the latter is attached to the buoy. This arrangement facilitates assembly but was designed primarily to avoid excessive play in the trigger-rod system which would be required to permit installation of the crash plate into a base ring already attached to the case. The two case sections are shown in Figure 7.

Drift float

The inflated drift-float, as seen in Figure 3, forms a cylinder approximately 14½" in diameter and 13" high which surrounds the upper case section. It was designed and

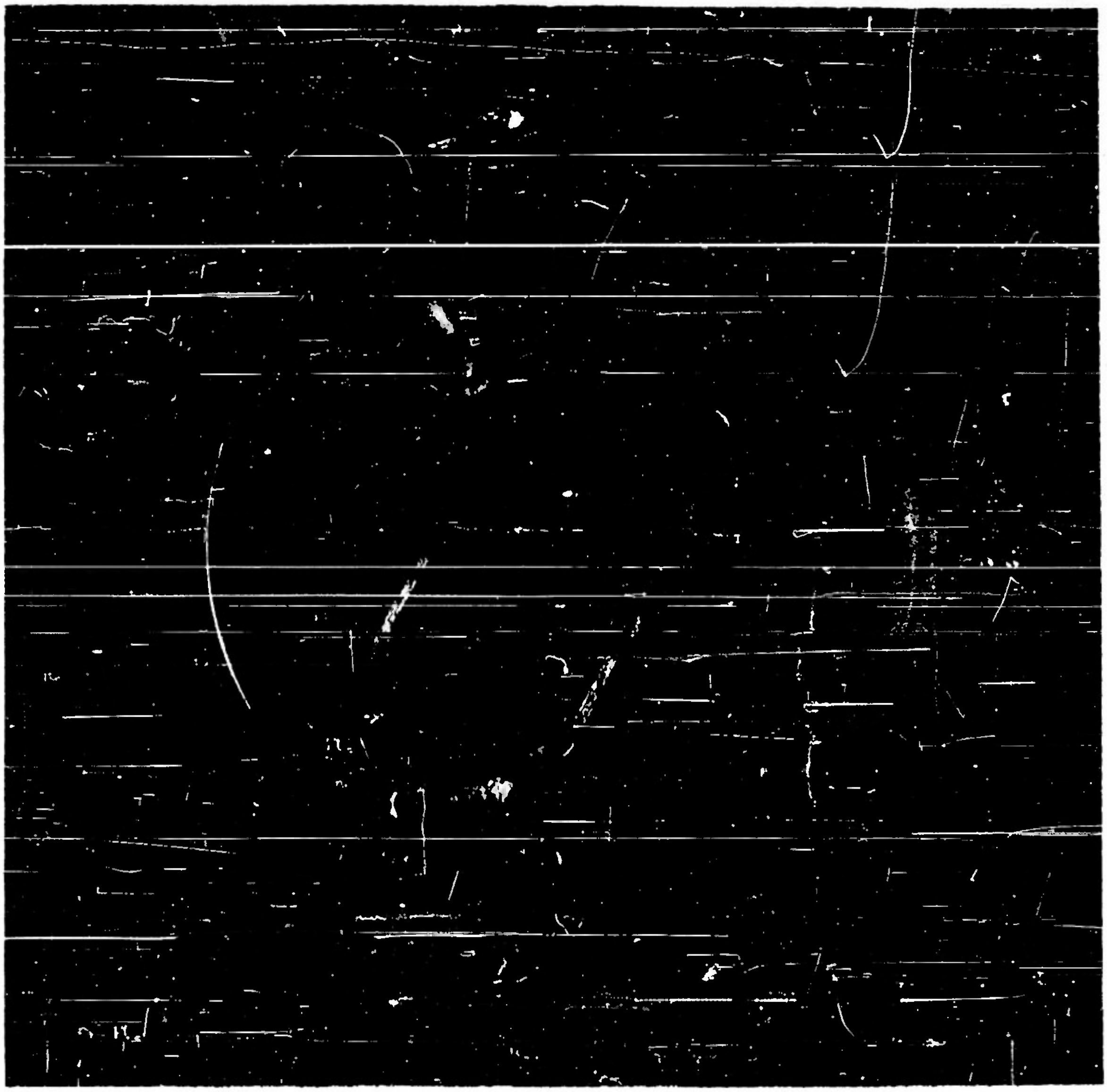

Fig. 5 View of interior of upper case from flanged coupling end.

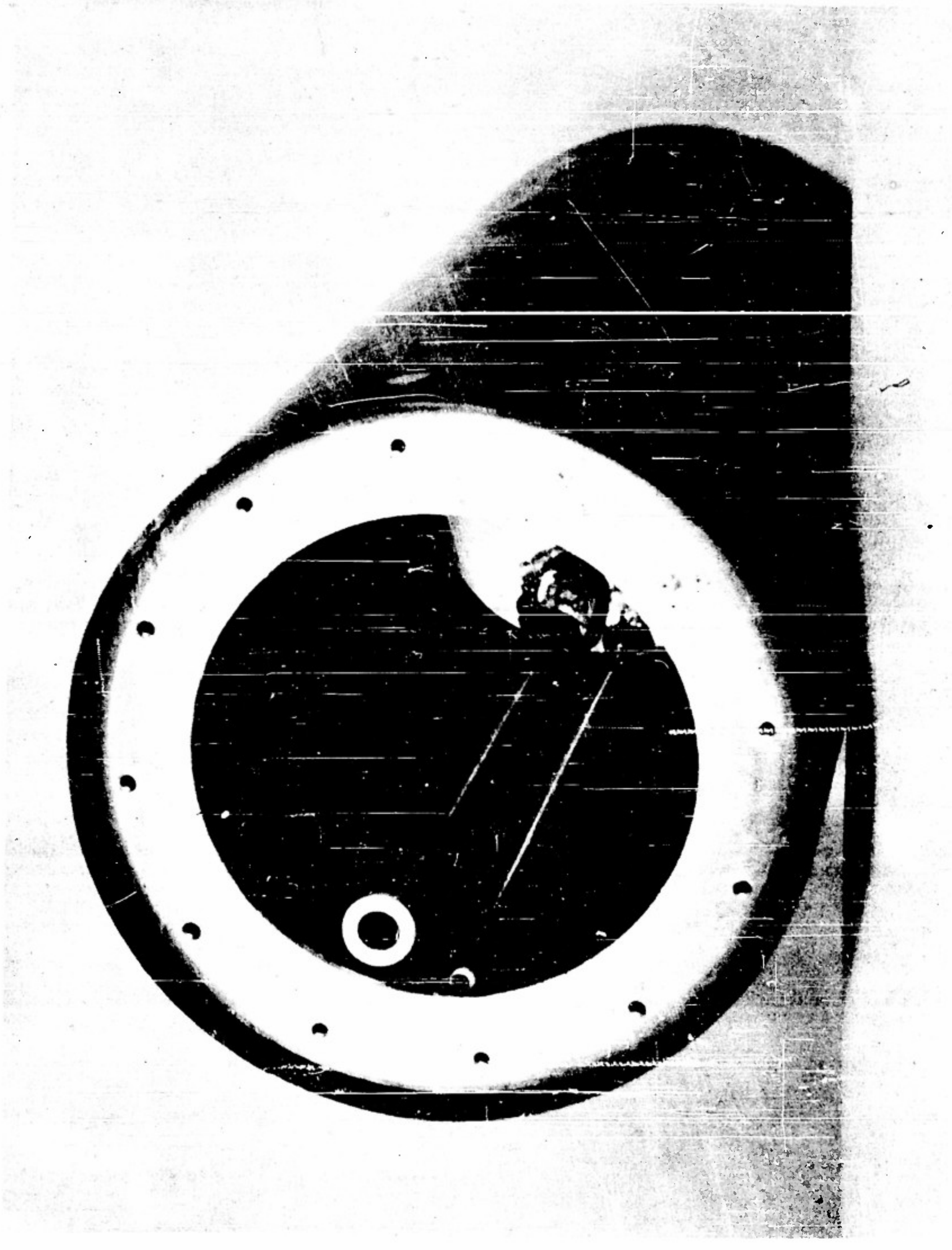

Fig. 6 View of interior of lower case from flanged coupling end.

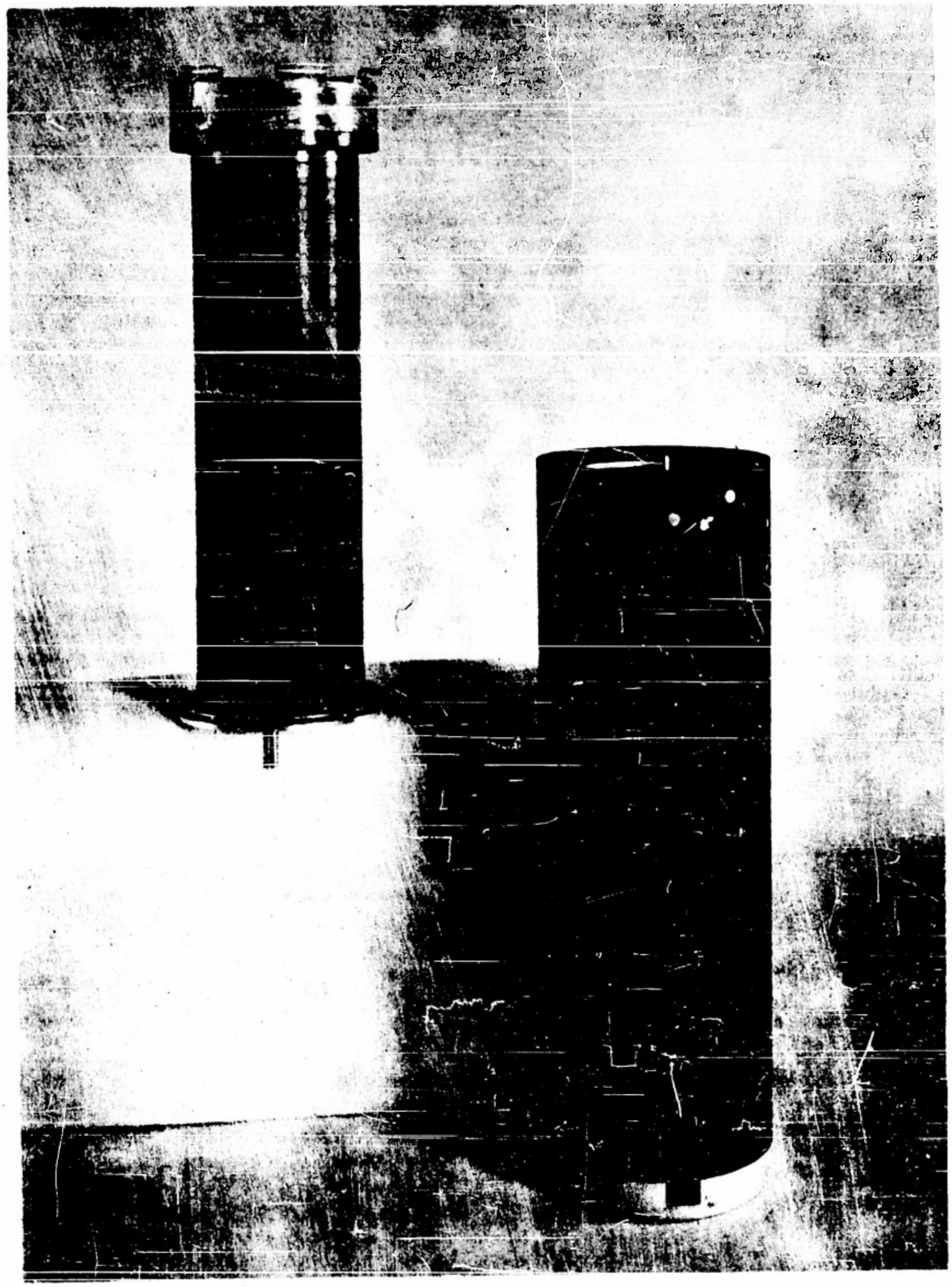

Fig. 7 Upper and lower cases.

fabricated by the Hodgman Rubber Company to specifications which included only the dimensions for the inflated float and the provision for mounting by wrapping around the 3 5/8" diameter tube rather than by drawing over the end. In construction it consists of two separate gas cells which are joined on one side of the buoy by fabric strips at both the inner and outer diameters and on the other side by lacings. The two inflation fittings lead through holes in the case to two matching fittings of the gas manifold. Float material is a neoprene coated nylon fabric which has adequate strength and yet is sufficiently thin and flexible to be folded and packed in the restricted space between case tube and float covers which is illustrated in Figure 8.

Float covers

The three float covers are actually sections of the upper part of a sonobuoy case and are used primarily as a protection for the float against physical damage prior to and during launching. When in position the aluminum strip at the bottom of the cover plates fits inside the extended rim of the lower case tube. The plate is held down by the small angle attached to the plate about 1¼" from the upper edge which fits under the top case ring. When retaining band is released the top of the plate is free to move outward to clear the hold-down angle and the plate can lift out of the lower case ring.

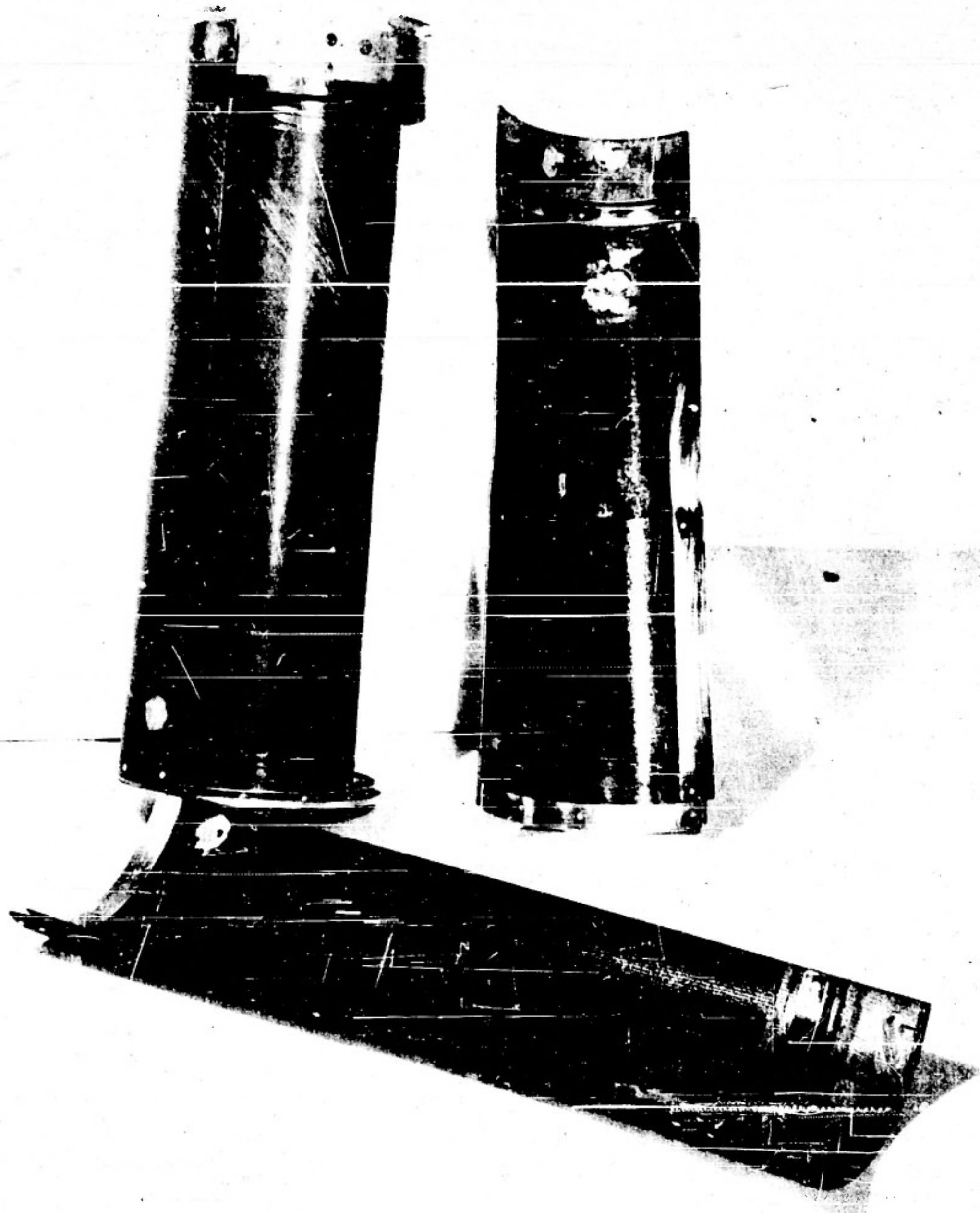

Fig. 8 Upper case and float-shield segments. One segment in position, showing space for folded float.

Acetylene generator

The cylindrical generator case is a $2\frac{1}{2}$" diameter recess $3\frac{1}{2}$" deep in the bottom end-piece of the buoy case as shown in Figure 9. The only fitting permanently attached to the case is the gas outlet fitting at the top. All other components are mounted on the base plate and are removable for adjustment or repair. The principal components consist of a partition, sealed by an O-ring which divides the case into 2 compartments, a collapsible water reservoir, a water inlet tube with check valve, a water feed tube with metering stem and seals for water and gas openings into the lower compartment. Figure 10 shows the complete generator assembly. The space below the partition, enclosed in an aluminum screen, is the carbide container. The sole function of the screen is to facilitate charging and assembly. It is not an absolute necessity but has proved to be a worthwhile convenience. The partition, which may be considered to be a stationary piston, is supported $2\frac{1}{2}$" above the base plate by the two hollow posts which also serve as water passages. The water inlet passage (on the left in Fig. 10) leads from outside, through the partition, to the water reservoir pan. The water feed passage leads from the water reservoir pan, through the partition and base plate to the bellows which is mounted below the generator base plate. From the bellows, holes through the base plate lead to distribution ducts at the bottom of the carbide chamber. In normal position, the end-plate of the bellows clears the end of the water inlet tube but when the

Fig. 9 View of interior of lower case, showing gas generator chamber and base ring.

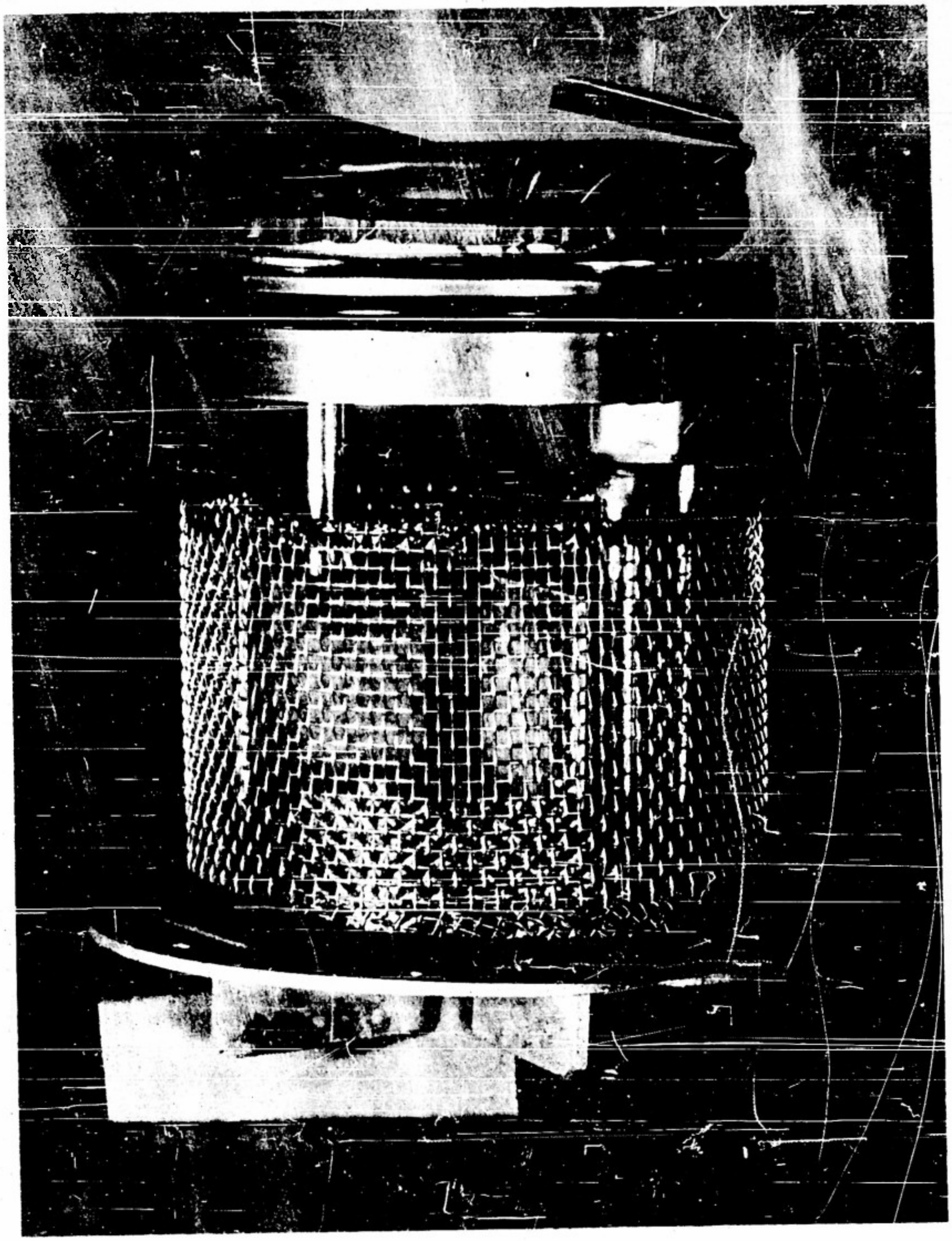

Fig. 10 Gas generator assembly.

bellows is compressed by an external spring, which rests on the dye-marker plate, the end of the bellows is held against the water tube and seals it. A soft rubber disk is cemented to the bellows end-plate on the inside and a helical spring is mounted around the water tube to supplement the inadequate spring action of the bellows. Adjacent to the water tube and parallel to it is an aluminum rod (on the right in Fig. 10) the lower end of which rests on the rubber disk covering the bellows end-plate. A helical spring in tubular uppper end causes the rod to follow bellows motion. The short tubular section encloses the stub gas outlet tube which leads from the gas ducts located at the top of the carbide chamber to reservoir chamber above. The hole size of this gas passage is the major factor controlling rate of reaction when buoy is floating at the surface. When the bellows is compressed by the presence of the dye-marker plate, a rubber disk at the base of the tubular section of the rod rests against the end of the outlet tube and seals it.

The water reservoir is an aluminum pan which is covered with a cup-shaped diaphragm of thin neoprene. As seen in Figure 10, the diaphragm is collapsed into the pan. When water is introduced the diaphragm shape is reversed so that it extends above the pan. The size is such that the filled diaphragm occupies nearly all the space above the reservoir pan without stretching. This was designed to expedite filling the reservoir under conditions of minimum water head, before increasing gas pressure eliminates the pressure difference.

The function of the reservoir is to supply sufficient water to complete the reaction after gas pressure equals external water pressure at the generator position. The inlet check valve, which is a rubber disk covering the opening of the inlet passage into the reservoir pan, serves to prevent discharge of water or gas when generator pressures exceed external water pressure.

The initial rate of flow of water into the carbide chamber is modified by the spirally grooved metering rod which is fitted into the water feed tube. The amount of restriction was experimentally determined to result in the maximum rate of reaction that could be attained without foaming or over heating to the point where some of the water was vaporized.

The size and number of cooling fins was determined more by space limitations than heat transfer requirements and hence forced a compromise on the reaction rate. They are four in number and extend about 2" into the carbide chamber and ½" outside the base plate. In construction, the fins are 1/16" aluminum plates which extend through slots in the base plate and are brazed in position.

Activating mechanism

The prime mover of the activating system is the sonobuoy crash plate which is retained by three lugs extending into openings in the base ring. The openings are about ½" high to allow vertical displacement and the lugs are held against the bottom edges by the downward thrust of a relatively heavy "U"

spring acting between the crash plate and the dye-marker plate above it. One lug is spring-retracted and provided with a turned down lip which latches over the lower edge of the opening. The lug spacing permits the crash plate to fall free of the base ring once an upward displacement has cleared the lip of the retractable lug from the base ring and lug has been withdrawn from the opening. The minimum upward displacement of the crash plate to effect release is the 1/8" required to clear the lip of the retractable lug. The maximum displacement is the ½" height of the lug openings in the base ring on the side of the non-retractable lugs, while at the position of the retracted lug, where the trigger rod foot is located, the edge of the plate reaches no limiting stop until it contacts the dye-marker plate nearly 1" from the initial position. Under normal conditions of operation, the crash plate displacement may be expected to vary between the limits of 1/8" minimum and ½" maximum. The crash plate, dye-marker plate and base ring assembly mentioned above are AN/SSQ-2 sonobuoy parts unmodified except for a hole in the dye-marker plate through which the rod of the trigger-foot passes.

The trigger-foot or trigger-rod foot is an unmodified sonobuoy part which is a 3/32" diameter rod about 6" in length having at the lower end a ring, the plane of which is normal to the rod axis. This foot ring rests on the crash plate and the rod extends vertically through a hole in the dye-marker plate and into 3/16" OD trigger-rod tube. This tube, which is constructed in two sections joined at the transmitter switch mechanism,

extends vertically through the buoy case from the bottom end piece to the rotor-release trigger on the top ring. To avoid any possibility of excessive stick friction of water-tight packings, these items were omitted and the tube made free flooding. The distance of the trigger-rod tube from the central axis of the buoy was determined by the internal diameter of the upper case and had a considerable influence in the design of the gas generator and battery compartments in the lower case. In the final design, the bottom end of the tube is expanded into a tapered hole in the lower end-piece and the tube passes through the ¼" annular space between the outside of the generator casing and the inside of the battery-pack tubing, is a press fit in a hole in the extended top flange of the generator and passes through the A battery compartment to the slip-joint in the lower end of the transmitter switch mechansim. The upper tube section extends between the transmitter switch mechanism and the rotor release and is a press fit at each end. One 1/16" diameter trigger-rod extends from the upper end of the foot to the under side of the trip-lever of the switch actuator and a second extends from the top side of the lever to the trigger of the rotor release.

The transmitter switch mechanism is a toggle arrangement that holds two GE "switchetts" of the "normally closed" type in the open position until triggered by impact. One arm of the toggle linkage is a bar with locations for hinge pins separated by 3/16". The end location is a 1/16" hole that receives the pin mounted at the free end of a flat cantilever

spring. The midpoint location is a round end slot which receives the connecting member of the "U"-shaped 1/16" wire which is the second toggle arm. Thin link plates with 1/16" holes at either end to receive both hinge pins are located on both sides of the bar and hold the linkage together. The bar-link is offset upward and extends beyond the midpoint hinge 3/16". The legs of the "U"-shaped toggle arm are knife-edged on the ends and pivot in a groove machined in the housing. The assembly drawing in Figure 11 shows the toggle in preimpact position. A displacement of the lower trigger-rod upward by 1/8" moves the midpoint hinge across the centerline of the joint and reverses the direction of the resultant of the cantilever spring thrust. When the cantilever has reached its limiting position against the body of the case then further displacement of the lower trigger rod will tilt the hinged toggle bar upward until it swings clear of the rod, permitting it to enter the upper tube. The mechanism may be reset to the "switch-off" position by first returning the lower trigger rod to its initial position which will allow the hinged toggle bar to fall back until the knife edges of the U-bar contact the case groove. The upper trigger-rod may be depressed to force the toggle linkage back across the pin center line to preimpact position. Since the mechanism case is free flooding along with the trigger-rod tube, it is made water-tight by a flexible rubber gasket edge-clamped over the case opening. The loose center of the gasket lies between the toggle-actuated cantilever spring inside the case and the switch actuating spring

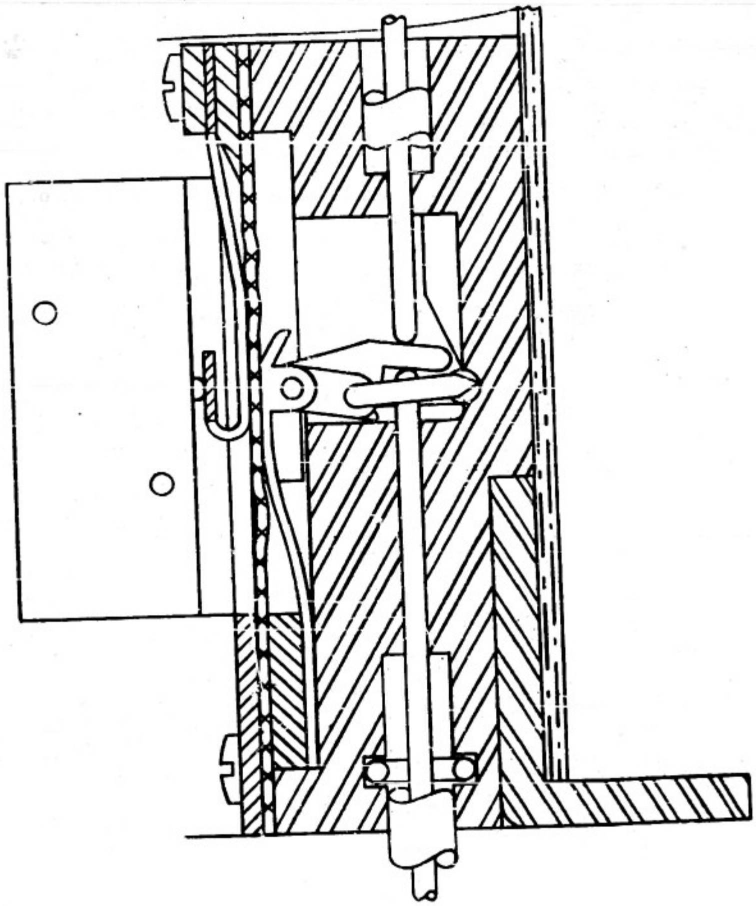

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Fig. 11 Switch Assembly.

outside. The hydrostatic pressure on the diaphragm-gasket is not sufficient to hold the switches open when the buoy is floating at it lowest position with a deflated drift float.

Only two modifications have been made in adapting the sonobuoy rotor release system to the ASR Drift Buoy. Of these the only one of consequence is the introduction of a spring-loaded, impact-triggered plunger used to drive the locking hook out of the rotor retaining spring ring. The assembly drawing of this device is shown in Figure 12 which is self explanatory. The other modification is the addition, by brazing, of a 16 gage stainless steel tab to the retaining ring. This tab serves to retain the float-shield clamping band.

Battery stowage

The B battery consists of 13 packs of vertically stacked cells and the transistor oscillator battery consists of a single similar pack. These factory-assembled packs are about 7" long and 11/16" in diameter. This set of batteries weighs approximately 4.3 pounds and should be located as low as possible in the buoy case for reasons of stability. Consideration of the probable deceleration forces which would be associated with this relatively large mass, as well as stability led to the selection of probably the least accessible location for battery stowage.

The 14 packs are placed in the space between the gas generator and buoy case where their weight is carried by a

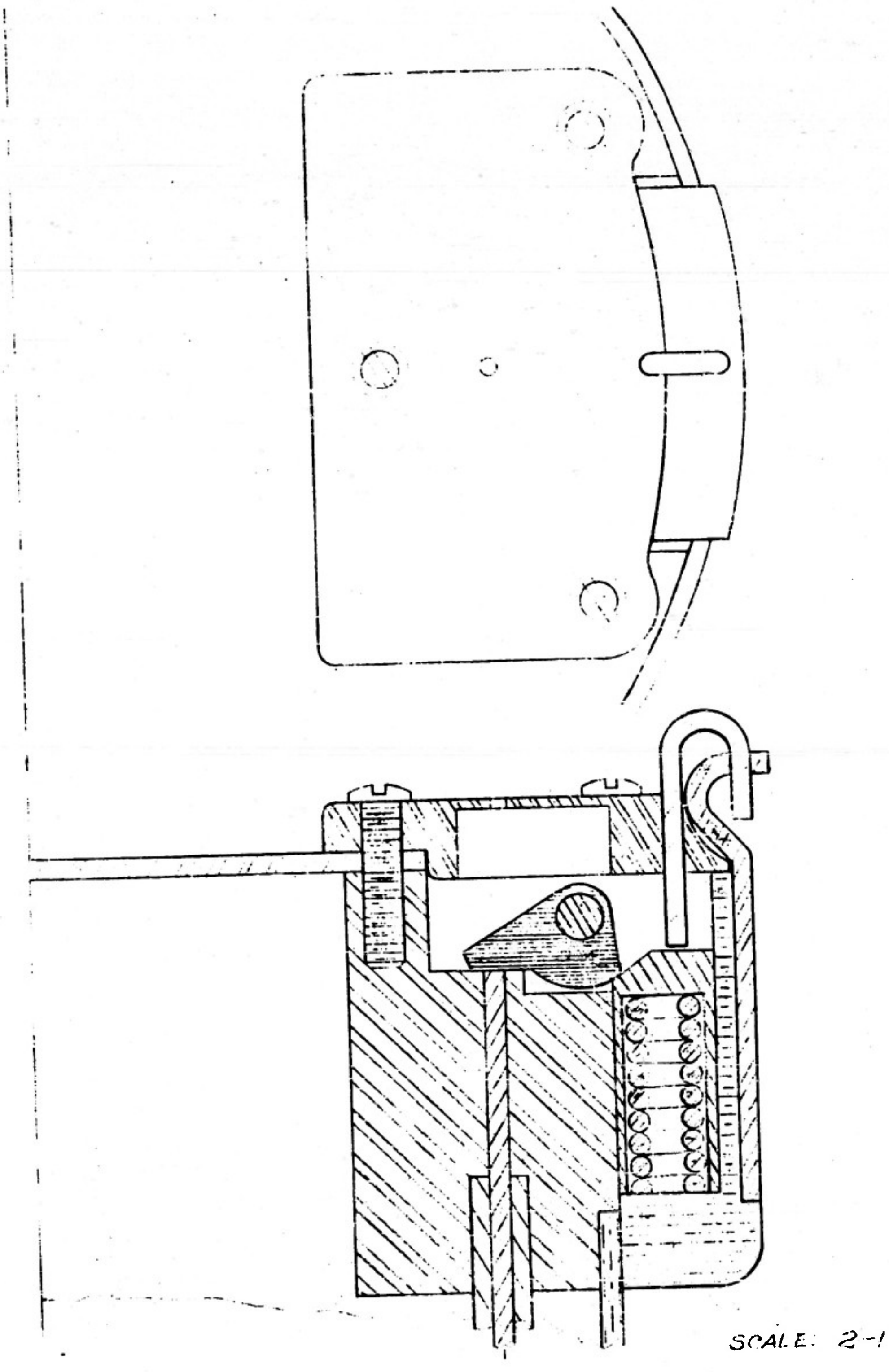

Fig. 12 Rotor release assembly.

collar which rests on inside of the end-piece flange on the outside of which the base ring is attached. The packs are given some circumferential pressure by soft pine packing strips and wedges and are separated from the generator case by a $3\frac{1}{4}$" OD linen-reinforced phenolic resin tube which extends about 4 inches above the packs. The A battery pack is a rectangular prism in shape which weighs about 2.4 pounds. It is stowed in the centrally located $3\frac{1}{4}$" tube and the weight is carried by the upper end of the generator case.

There are sponge rubber pads under the battery packs and at the top between batteries and hold-down plates. Figure 13 shows the battery packs and packing strips assembled outside the case. The B battery packs are taped together in three groups of 5, 5 and 4 and the leads between groups are made sufficiently long to permit installation of one group at a time through the restricted clearance of the case coupling flange. When batteries are in place, the separator tube is inserted, then the top rubber pad and the two halves of the annular hold-down plate are installed. The locking strips are then placed between the hold-down plates and the lower edge of the case collar. After the A battery with its packing strips has been placed inside the tube, the offset cross member is snapped under the catches provided in the locking strips. This member serves as an A battery hold-down and a locking strip retainer. All battery leads run to the female side of a line junction multiplug, the male side of which is connected to the lines to the equipment in the upper case.

Fig. 13 View showing general arrangement of A and B batteries, packing strips, etc.

Shock test of structure and of electronic and mechanical elements

A test was conducted to determine the ability of the various structural, mechanical and electronic components to take the forces resulting from water impact without critical damage. The terminal velocity of an AN/SSQ-2 sonobuoy has been given as 30 to 35 miles per hour when equipped with rotor. Without rotor this terminal velocity is attained in 55 feet of "free" fall. In this test, experimental model No. 2 was dropped into 25 feet of water from 55 feet, 75 feet and 100 feet. The buoy was visually inspected for indications of damage after the first 2 drops and was completely taken down and each component examined after the 100 foot drop. No damage of any sort was evident.

The first functional test of a completely assembled buoy (less rotor) was made with experimental model No. 1. The release mechanisms functioned correctly and the transmission signal was received 12 seconds after the buoy came to the surface. The rate of inflation of the drift float was less than desirable since full inflation occupied a 45 minute interval.

As a result of this test the generator case was increased in size and the metering orifices and passages adjusted to a higher rate of reaction.

III ELECTRONICS DESIGN

General specifications

The transmitter of the ASR Drift Buoy is designed to provide a reliable and distinctive modulated radio signal, capable of being received and homed upon by search craft, using the Guard channel of Ultra High Frequency (UHF) receiving and homing apparatus. Aircraft receiving equipment AN/ARC-27 and direction-finding adapter AN/ARA-25 are suitable for this purpose.

The buoy's electronic equipment has been designed to withstand temperatures normally encountered in aircraft operations and to function normally following a drop from aircraft in distress. Tests of the transmitter indicate no serious impairment of transmissions resulting from buoy storage at low temperatures and transmissions have been satisfactory when the buoy has been in water near the freezing point. The tubes have an absolute maximum impact rating of 500 G's and 60,000 foot altitude rating.

Sub-miniature tubes and components are used throughout to maintain small physical size and weight. High quality components and silver-plated inductances contribute an over-all improvement in efficiency.

General Circuit

The transmitter consists of an overtone crystal oscillator, a frequency doubler stage, a parallel doubler-final amplifier, modulator, and tone oscillator. (See Fig. 14.) All stages, with the exception of the tone oscillator, use

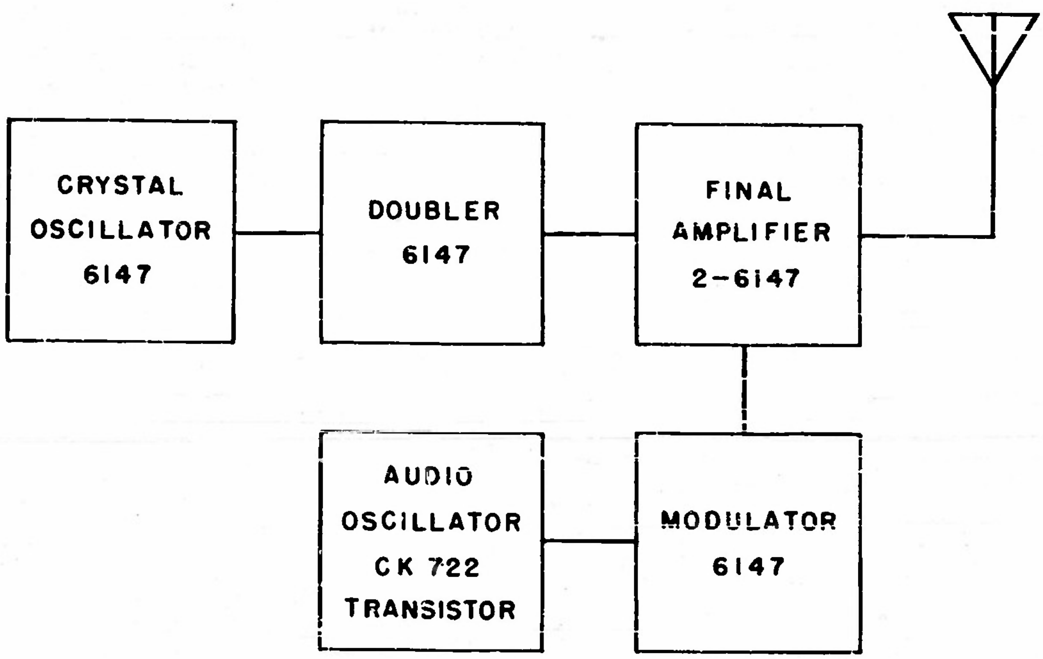

Fig. 14 Block diagram of transmitter.

Raytheon CK-6147 sub-miniature tubes. The tone oscillator uses a Raytheon CK-722 transistor. The output frequency is 243 megacycles, amplitude modulated by a tone of approximately 700 cycles.

Circuit Description

The crystal oscillator is designed to provide an output at 60.75 megacycles using an overtone type crystal. The tap on inductance L-1 controls the crystal excitation voltage and is adjusted for the minimum excitation necessary to provide positive crystal operation. This tap is a radio frequency ground potential due to bypass condenser C-3, and provides less feedback as the tap is lowered. (See Fig. 15.) Oscillator tuning is accomplished by means of C-5, a small ceramic trimmer condenser which is normally tuned until crystal lock-in, at the proper frequency, is obtained. After tuning, the transmitter should be keyed several times, making certain that positive crystal lock-in is occurring. The oscillator output voltage is obtained through capacitor C-6 from the plate end of the oscillator tank circuit.

The doubler stage uses another CK-6147 sub-miniature tube and provides an output voltage at a frequency of 121.5 megacycles. This stage operates Class C and obtains its grid bias voltage from resistor R-4. The positive peaks of the excitation voltage cause electron flow from the filament to the control grid, thence through R-4 and returning to the filament producing around 60 volts of bias at the control grid. Capacitor C-10 is tuned for maximum output at 121.5 megacycles. The filament

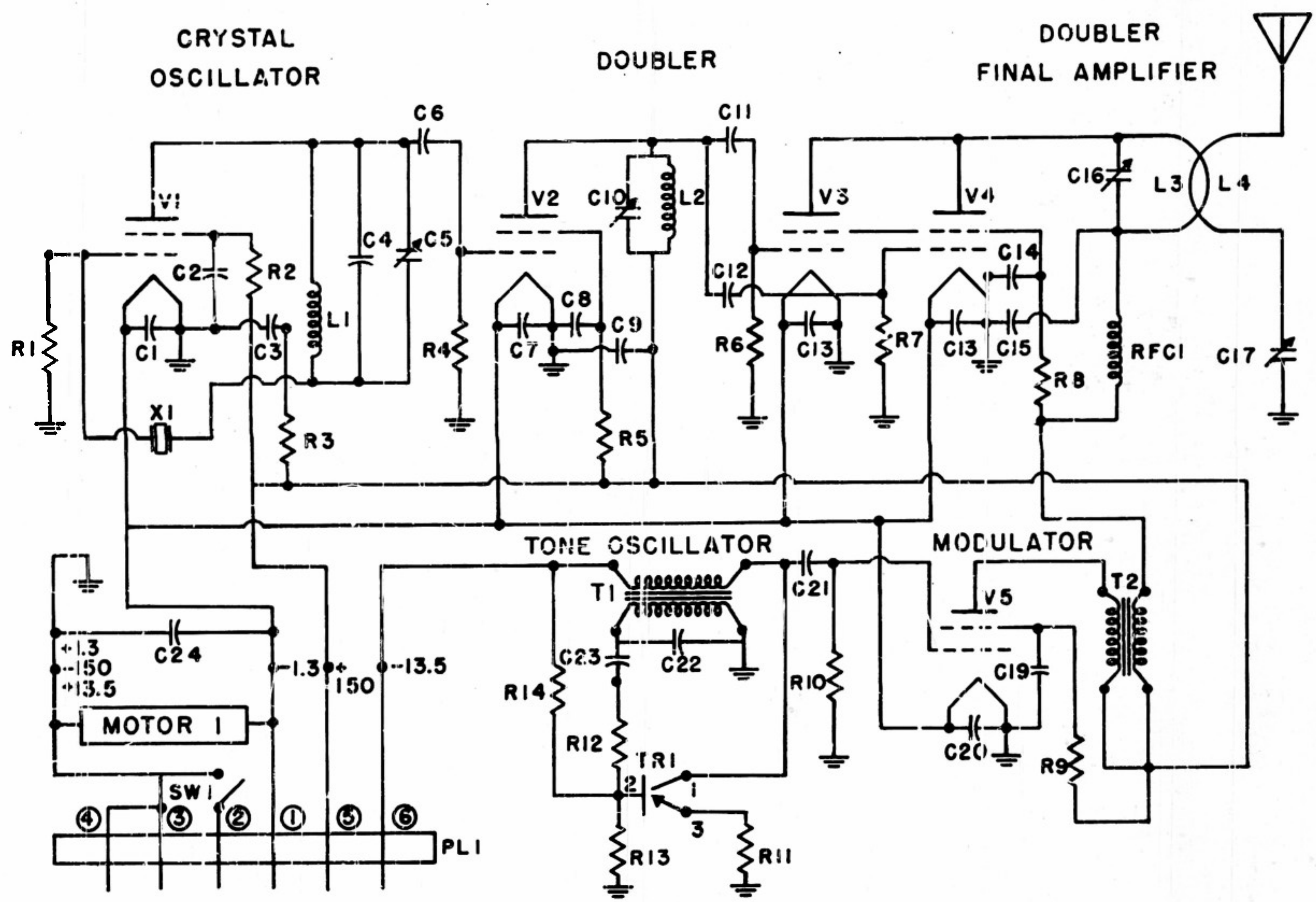

Fig. 15 Schematic diagram of transmitter.

and screen bypass condensers are physically small with a minimum of lead lengths and inductance L-2 is silver-plated to reduce skin effect losses.

The final amplifier consists of two CK-6147 tubes, connected in parallel, designed to provide a modulated output at 243 megacycles. Separate grid coupling condensers and bias resistors are used to allow each tube to "find" its own operating point. This minimizes unbalance of plate and screen currents which could occur in unmatched tubes with identical grid voltages. Short leads and small by-pass condensers connected directly to the ground side of the filament are used in this stage to reduce series inductance and shunt capacitance effects. Tube shields are placed only over the upper end of the tubes to reduce plate to ground capacitance. The plate tank inductance L-3, consists of a "U"-shaped coil, silver-plated and mechanically rigid. Tuning is accomplished by means of capacitor C-16, a ceramic trimmer condenser. The antenna is connected to coil L-4, which is coupled to the plate tank inductance L-3. Matching to the base impedance of the quarter-wave antenna is facilitated by means of condenser C-17. Both C-16 and C-17 are tuned for maximum output power at 243 megacycles. Both the plates and the screens are modulated to prevent excessive screen dissipation during the modulation cycle.

The modulator consists of a CK-6147 tube which provides 130 volts R.M.S. modulating voltage across the secondary of the modulation transformer T-2. This is sufficient

to modulate the final amplifier 100 per cent. R-10 allows sufficient grid bias voltage to be generated at the grid of this tube to operate class A. The load impedance under these conditions is approximately 10,000 ohms. The modulation transformer T-2 matches this impedance to the class C radio frequency amplifier load impedance which is approximately 3,500 ohms. The screen obtains its voltage from dropping resistor R-9 and any alternating current present at the screen is by-passed to ground through condenser C-19.

The tone oscillator utilizes a CK-722 junction transistor which operates satisfactorily over the range of operating temperatures encountered. The power drain is reduced considerably by this choice, with less than 5 milliwatts expended. The oscillator is a grounded emitter type, which provides sufficient driving voltage to the modulator at the proper impedance level. Transformer T-1 is a sub-miniature unit, occupying a minimum of space and effecting a weight reduction over standard transformers.

To maintain frequency and amplitude stability over the range of voltage and temperature requirements, the base bias is fed by a bleeder network consisting of resistors R-13 and R-14. Resistor R-11, which is in series with the emitter, is not by-passed, thus providing degenerative feedback, improving the output voltage regulation and waveform. The frequency is further stabilized by shunting transformer T-1 primary with a condenser C-22, to form a tuned feedback circuit. The output voltage from the oscillator is 4.2 volts R.M.S. at a frequency of

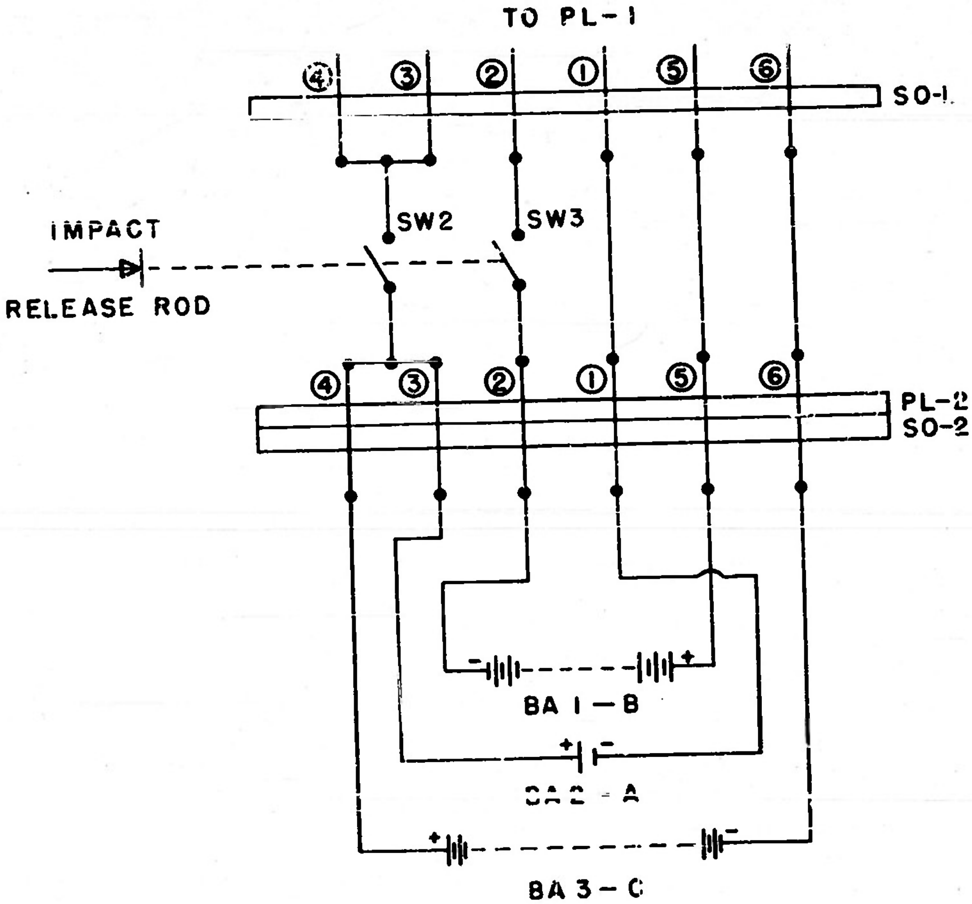

Fig. 16 Schematic wiring diagram of battery and plugs.

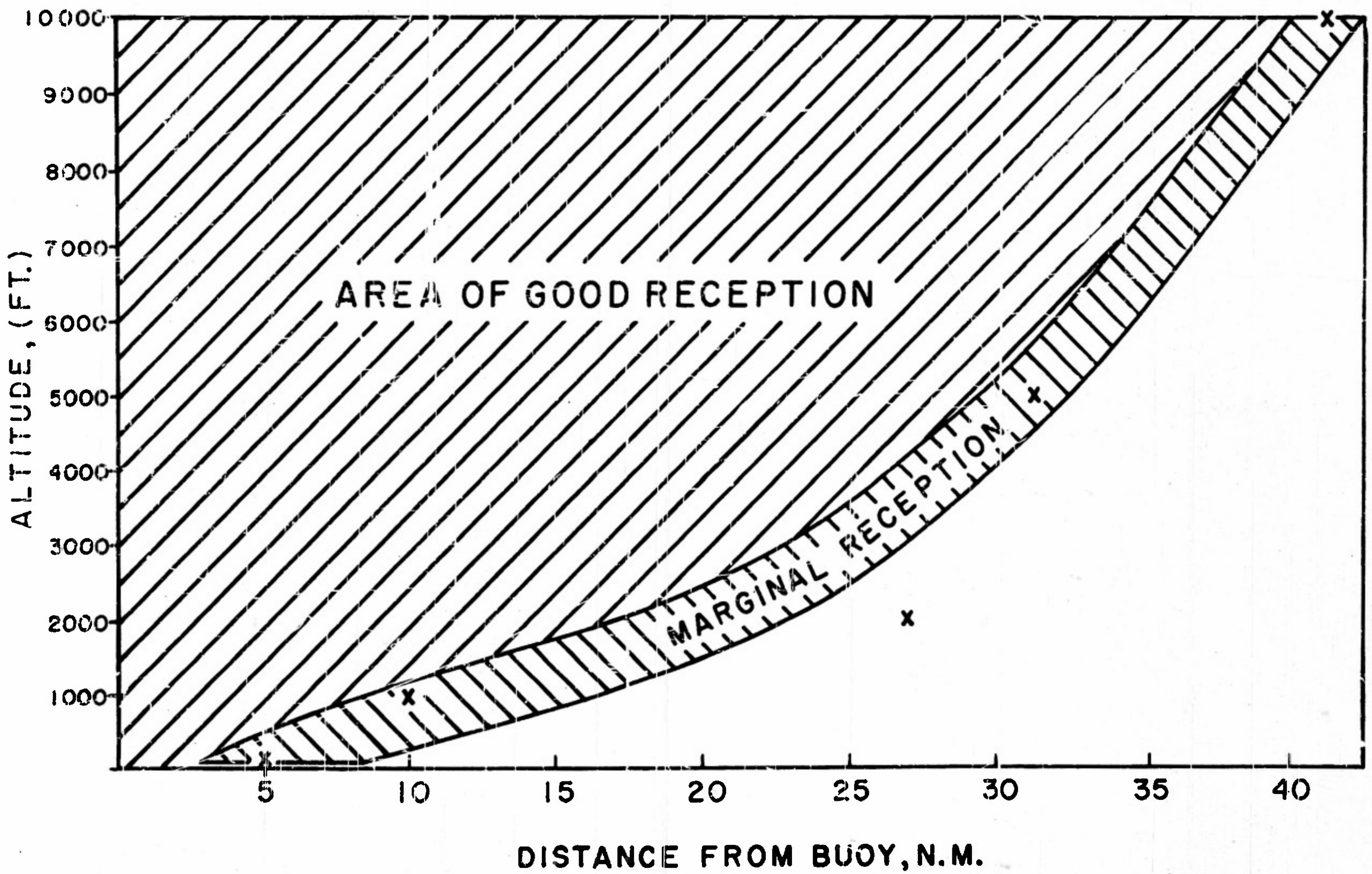

Fig. 17 Reception of buoy signals by PBY aircraft using AN/ARC-27 receiver. Graph of range vs. altitude.

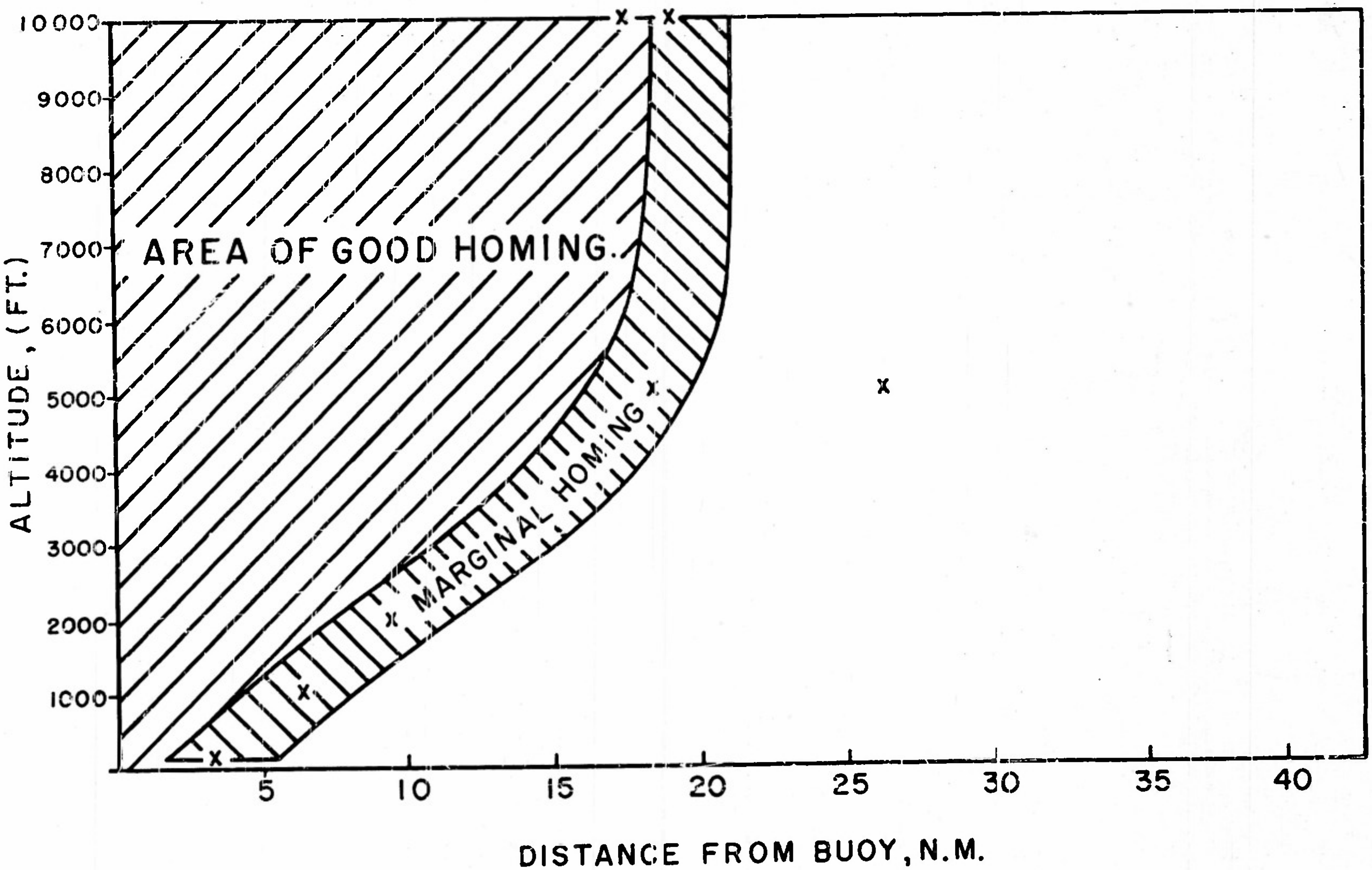

Fig. 18 Homing on buoy signals by PBY aircraft using AN/ARA-25 Direction-Finding Adapter with AN/ARC-27 Receiver. Graph of range vs. altitude.

700 cycles. The D.C. power expended in the bleeder stabilizing resistors R-13 and R-14 is 1.24 milliwatts, or 20 per cent of the total input power to the stage.

The keying motor keys the transmissions by switching the negative B lead. The test models have a keying cycle of five seconds, the transmitter on for two seconds and off for three. Operational models may be fitted with keying cams cut to provide any combination of letters and bearing dashes desired. (See Fig. 19.) To maintain the same life characteristics as are found herein, the duty ratio given should be adhered to, although an increase in transmitter off time will provide an attendant increase in battery life. A keying sequence such as that of Example 2 (Fig. 19) provides the proper duty ratio when averaged over two complete cycles. Many other combinations are possible but the length of the bearing dash should not be less than 2 seconds when AN/ARA-25 Homing Equipment is to be used. This unit provides an indication of relative bearing on a remote reading indicator. Rotation of the pointer takes place at a more or less constant rate during signal reception, so that a keyed signal such as the buoy transmitter signal will move the pointer in discrete steps only during the ON periods. To expedite rescue operations it is advantageous to transmit sufficiently long bearing dashes to obtain the correct bearing to the buoy as soon as possible after contact is made.

The impact release rod, upon striking the water, closes switches SW-2 and SW-3 energizing the transmitter filaments,

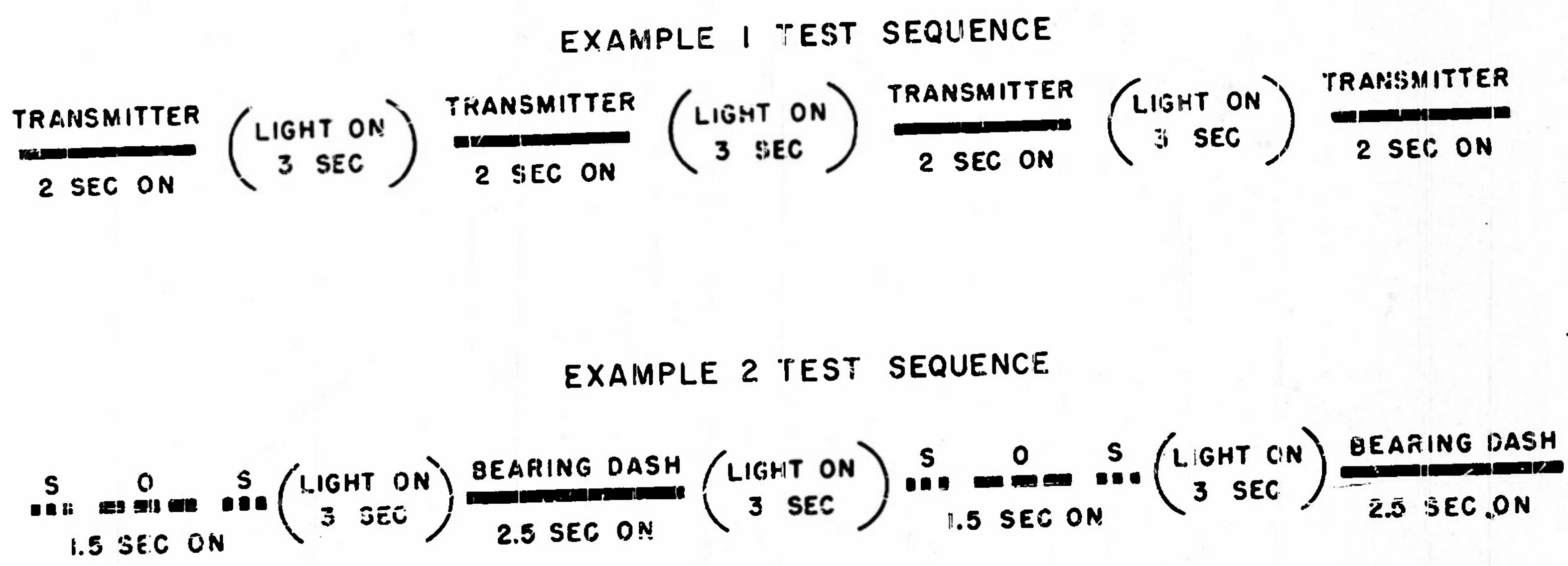

Fig. 19 Keying sequence of buoy transmitter. (Buoy light is off while transmitter is on, and vice versa.)

the tone oscillator, and the keying motor and provides the negative 150 volts to the transmitter through the keying contacts.

Plug PL-1 is located on the transmitter chassis and allows the chassis to be removed for inspection or testing without the removal of the batteries. Test cord TC-1 is an accessory, made up of appropriate plugs to enable the transmitter unit to be tested or tuned on the bench, yet connected to the buoy battery supply. Dow-Corning DC-4 silicone grease is applied to all plug contacts during assembly to ensure good electrical contact and to provide a coating resistant to the effects of sea air and moisture.

The batteries used are Rubien-Mallory mercury cells, packaged to conform with the buoy space requirements, by P. R. Mallory and Co., Inc. The choice of mercury cells was based on the following factors:

1. High ratio of energy output to volume and weight
2. Long shelf life not affected by humidity
3. Relatively uniform discharge voltage
4. Resistance to impact
5. Leakproof construction

The A batteries consist of four separate battery packs connected in parallel, each consisting of six RM-12 cells connected in parallel. This combination provides sufficient power to operate the keying motor and filaments for nearly 100 hours. (See Life Tests, Fig. 20.)

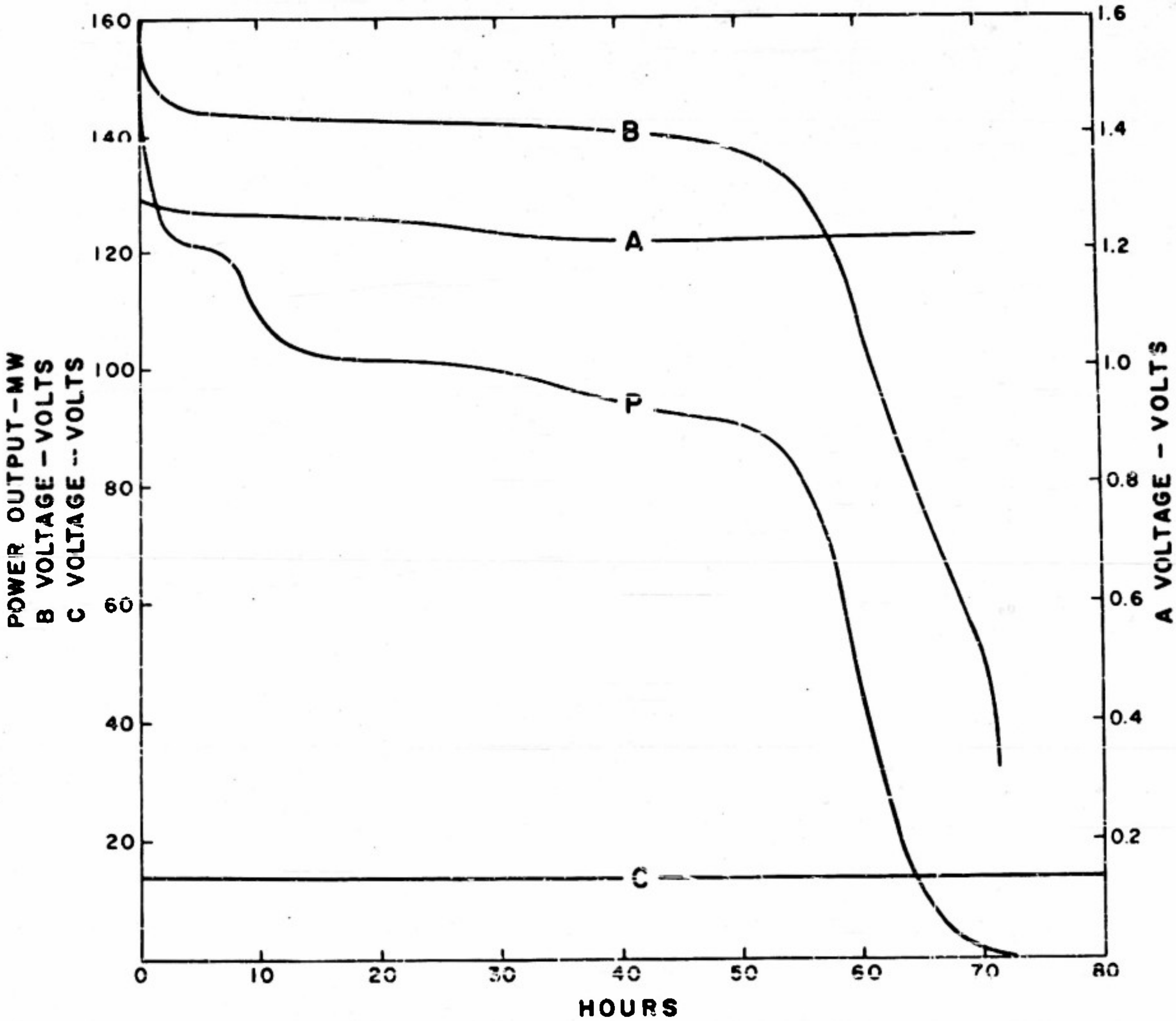

Fig. 20 Life test of transmitter. Graph of power output and voltages.

	E_p	E_{SG}	E_c	$I_p + I_{SG}$	E_c RMS	E_p RMS
OSC	122 MEAS. AT C3	122	−38			
DBLR	140	115	−60			
FINAL AMP	130 TOP T2 SEC.	103	−27	8 MA		100 TOP T2 SEC.
MOD.	132	120	−12.5		4.2	100

	E TERM. 1	E TERM. 2	E TERM. 3
TONE OSC.	−12.5	+0.4	−0.46

CONDITIONS OF MEASUREMENTS:

1. ALL MEASUREMENTS MADE WITH VACUUM TUBE VOLTMETER
2. A VOLTAGE = 1.25 VOLTS
3. B VOLTAGE = 140 VOLTS
4. C VOLTAGE = −13.5 VOLTS
5. POWER OUTPUT = 130 MW
6. A CURRENT = 0.66 A
7. B CURRENT = 50 MA
8. C CURRENT = 350 MICROAMPERES

Fig. 21 Voltage and current chart for transmitter.

Parts List

V1-Raytheon Tube 6147
V2- " " 6147
V3- " " 6147
V4- " " 6147
V5- " " 6147
TR1- " Transistor CK722
R1-Allen-Bradley 1/2W. 220k
R2- " " " 4.7k
R3- " " " 1k
R4- " " " 100k
R5- " " " 4.7k
R6- " " " 220k
R7- " " " "
R8- " " " 3.9k
R9- " " " 6.8k
R10- " " " 1.5M
R11- " " " 2.2k
R12- " " " 1.5k
R13- " " " 47k
R14- " " " 100k
C1-Disc Ceramic Cap. .002 Mfd.
C2- " " " .001 Mfd.
C3- " " " .002 Mfd.
C4-Erie Ceramicon Cap. 10 Mmfd.
C5- " " 1.5-7 Mmfd.
C6-Disc Ceramic Cap. 270 Mmfd.
C7- " " " .001 Mfd.
C8- " " " .001 Mfd.
C9- " " " 470 Mmfd.
C10-Erie Ceramicon 1.5-7 Mmfd.
C11- " " 25 Mmfd.
C12- " " 25 Mmfd.
C13-Disc Ceramic Cap .001 Mfd.
C14- " " " .001 Mfd.
C15- " " " .001 Mfd.
C16-Erie Ceramicon 1.5-7 Mmfd.
C17- " " 3-12 Mmfd.
C19-Metalized Paper.5/200 v.
C20-Disc Ceramic Cap..001 Mfd.
C21- " " " .01 Mfd.
C22-Metallized Paper .05/200 v.
C23- " " .1/200 v.
C24-Disc Ceramic Cap .001 Mfd.

Parts List

T1-AF Oscillator Transformer, Stancor UM113
T2-Modulation Transformer, Stancor A3812
MO1-Keying Motor 1.5 V DC Wilson
L1-Crystal Oscillator, 8 t, #18 Wire 3/8" D Tap 3 t. from cold and .3/4"L. Silver plated
L2-Doubler, 3 t. #16 3/8" Dia. 5/8" L. Silver plated.
L3-Final Amp., Silver plated 1/2 Loop #12, 11/16W. 7/8" L.
L4-Antenna, Silver plated #12, 11/16"W. 1"L.
RFC1-16 t. #22 wire close wound on 1/2 watt, 1 meg Resistor
SW1-Special switch on keying motor
SW2-G.E. Switchette Model 1070 SPST
SW3-Same as SW2
P11-Jones Plug P306FP
P12-Jones Plug P306CCT
S01-Jones Socket S306FP
S02-Jones Socket S306CCT
BA1-B-13 Mallory Mercury cells, series conn. Type No. SR-0431-3, 150 V
BA2-A--Mallory Mercury cells, 4 Type SR-0431-2 par. Conn., 1.3 V.
X1-Crystal Clark HSM-2H 60.750 MC.
TC1-Test Cord (Special)

Fig. 22 List of parts for buoy transmitter, batteries, and plugs.

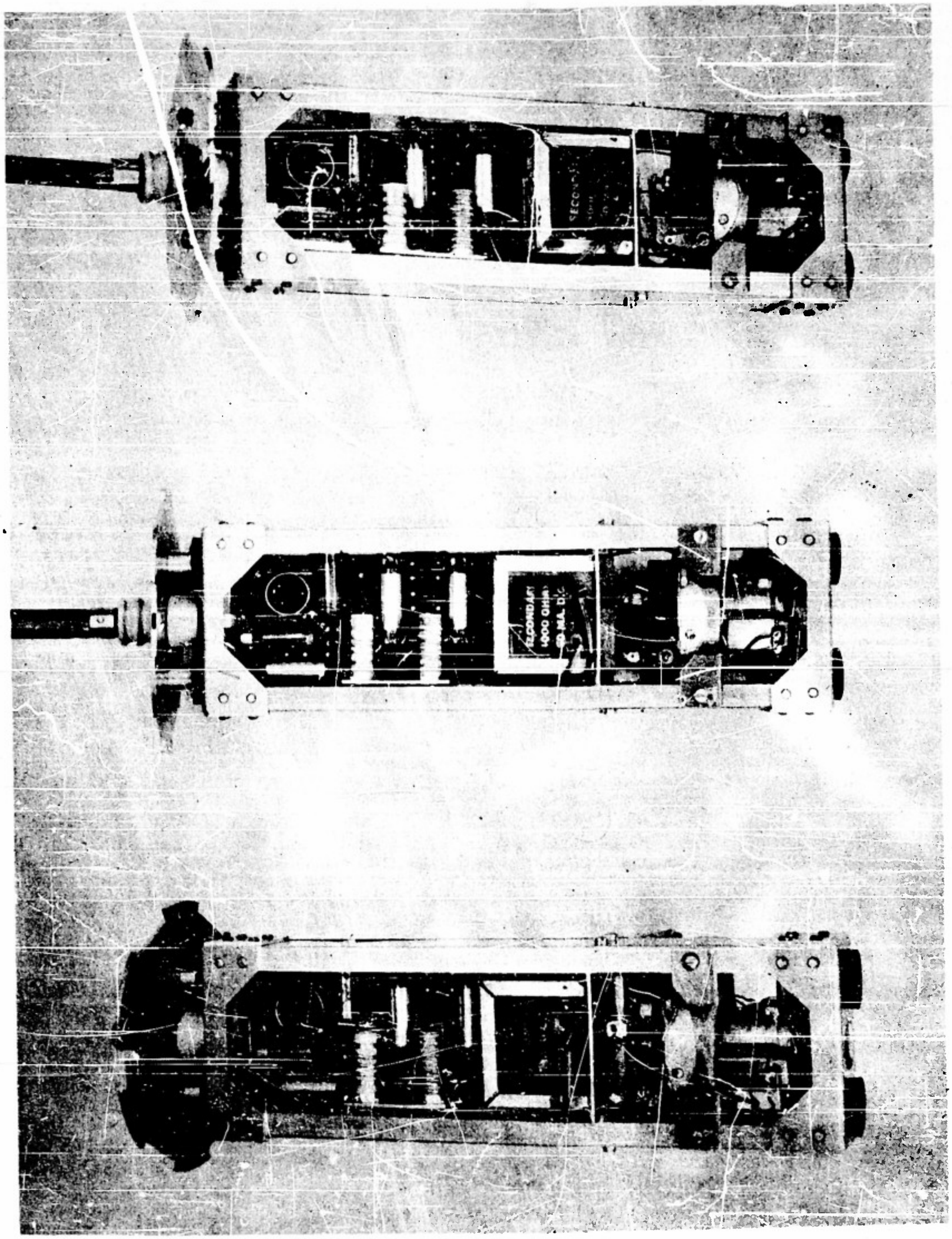

Fig. 23 Views of top of transmitter.

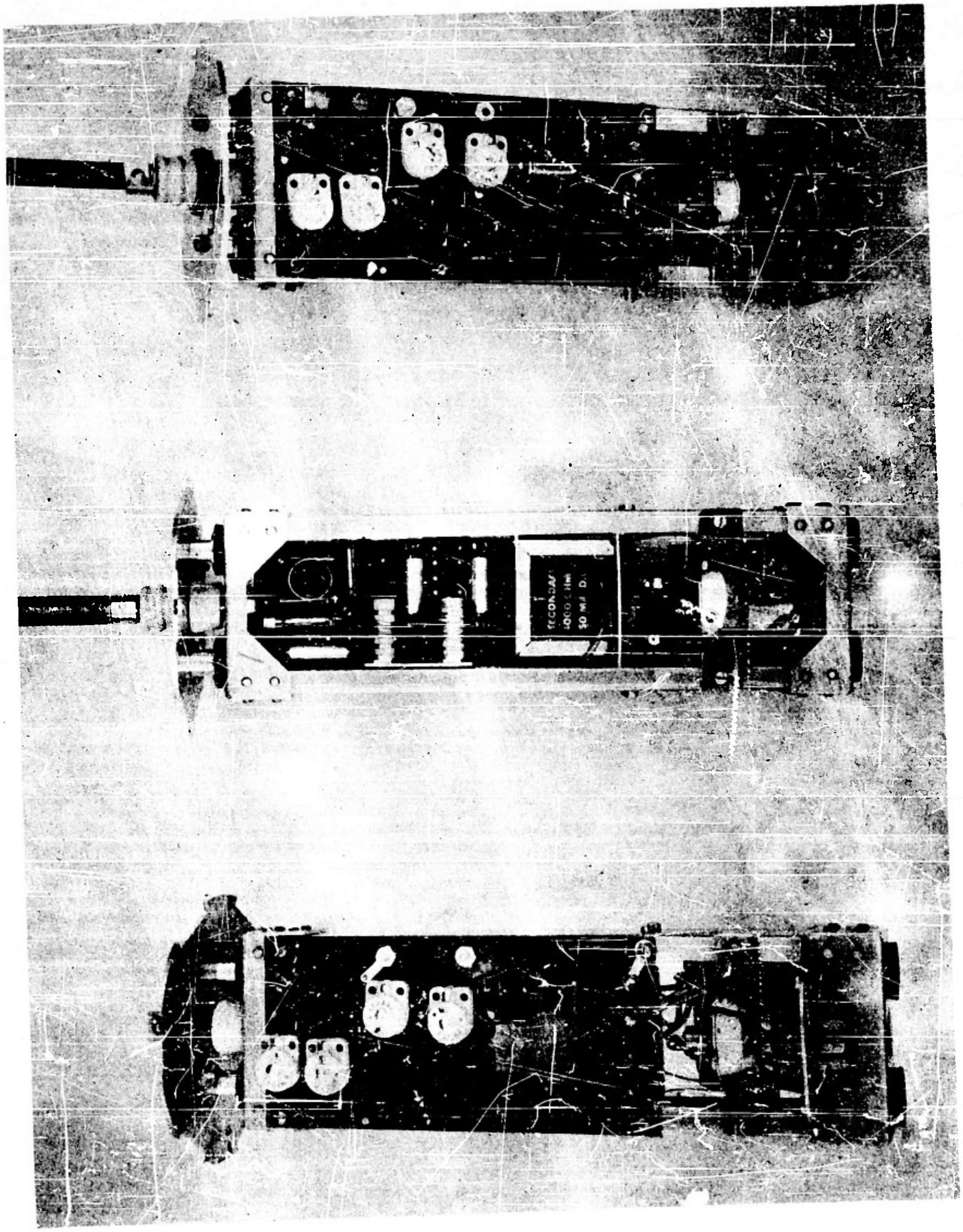

Fig. 24 Views of bottom of transmitter.

The B batteries consist of 13 series stacks of ten RM-1 cells in series to give approximately 160 volts. Using a keying cycle of 2 seconds on and 3 seconds off these batteries maintain a readable output signal from the transmitter during most of the life of the A batteries.

The transistor oscillator operates from a separate stack of ten RM-1 cells in series providing 13.5 volts. The drain on this battery is 350 microamperes, a value low enough to ensure tone oscillator performance during the life of the other batteries.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

Woods Hole, Massachusetts

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An Experimental Air-Sea-Rescue Drift Buoy

APPENDIX

By

F. deW. Pingree
Harold E. Sawyer
Robert G. Walden

Technical Report
Submitted to Geophysics Branch, Office of Naval Research
Under Contract Nonr-769(00)(NR-083-069)

March 1954

APPROVED FOR DISTRIBUTION [signature]
Director

APPENDIX

TESTS CONDUCTED BY WHOI

Performance trials of developmental models X-1 and X-2 have been conducted using the WHOI/Navy PBY-5A Aircraft. Because this aircraft is not equipped with ejectors, the buoys were released manually from a blister hatch. In other respects, the trials conformed to normal service conditions.

In the initial trial, model X-1 was released at an altitude of 1000 ft. and airspeed of 108 knots. The line-of-flight was level and cross-wind. The wind velocity was estimated to be 35 MPH. Observation of the buoy after impact with the sea and its recovery was made from a WHOI vessel. Observation of air travel was made from the releasing aircraft. The deceleration of the buoy in air, due to the auto-rotational cap, caused a rate of increase in the observing distance which was too rapid for successful photography and which limited visual observation to the early stages of fall.

While the buoy was under observation, in these early stages, the three float covers became detached so that the float was unprotected at impact with the sea. Subsequent examination proved that the float had suffered no damage because of this lack of protection. In all other respects the performance was satisfactory.

The signal was received by the aircraft at normal strength and standard repetition rate about 1½ minutes after

release. In the ten to fifteen minute period required by the surface vessel to reach the buoy position, the drift-float had become fully inflated. A photograph, made as the vessel neared the buoy, is reproduced as Fig. 1 of this report. The normal operation was allowed to continue for about an hour before terminating the test. After returning to base, the buoy was disassembled and examined for indications of physical damage, water leaks and gas leaks. A complete check was made of the transmitter including a measurement of frequency. The only digression from the designed performance pattern was the loss of float-covers before water impact.

The procedure of the second trial was similar to that of the preceeding one, with the exception that both model X-1 and X-2 were involved and the altitudes of release were 3000 ft. and 150 ft. The float covers used in this trial had been modified by the addition of an aluminum angle which replaced the 1/8" pin, previously employed as a hold-down. The buoys were assembled without sealing compound, as this simplified procedure had been followed in the preparation for some previous sea trials without adverse results. In this case, however, gaskets and water-proof grease were insufficient. Water leaks around base-plate screws in model X-1 and around the light mounting in the top-plate of model X-2 shorted one or more transmitter circuits.

Model X-1 which was released at 3000 ft., retained float-covers during the early stages of the fall but lost them

shortly before impact and model X-2, apparently, entered the water with float-covers in place.

The third performance trial was a repetition of the second conducted with models X-1 and X-2. In this instance, sealing compound was applied to all assembly screws and exposed edges of cover plates and coupling flanges. A minor modification was made in the float-cover retaining device which consisted of an arched leaf spring inserted between the retaining band and the locking tab. In both the 3000 ft. drop of model X-1 and the 150 ft. drop of model X-2, the transmitted signal was received by the launching aircraft shortly after impact. Examination after recovery disclosed no leakage or physical damage. It was noticed that in the case of model X-2 the locking hook had not been ejected entirely clear of one end of the spring ring and the buoy collar. Although this may have been due to the fact that the release plunger spring had been weakened during previous trials, the side-thrust introduced by the tension of the newly installed leaf spring obviously increased the stick-friction of the locking hook an undesirable amount.

The information gained from these tests led to the final modifications of float-covers and the float-cover retaining band and indicated that further alteration of the design for experimental models would be unnecessary.

OPERATION AND MAINTENANCE OF ASR EXPERIMENTAL DRIFT BUOY

Introduction

ASR Drift Buoys No. 1, 2, 3, and 4, were individually fabricated according to the accompanying construction drawings in order to furnish working models for general evaluation. They possess some features, notably the neutral gray color of the drift-float, which could be modified to advantage when the quantity manufactured warrants the production of special materials. Facility of maintenance operations cannot be given primary importance in a design of expendable equipment intended to function only once in an emergency without sacrifice of operational characterisitics. Consequently maintenance procedures are rather involved. For the same basic reasons, operational procedures are rendered as simple as possible.

Operation

Unless otherwise noted in special instructions attached to the individual buoy, experimental models are packed in normal prelaunched conditions. The only operation to be performed before ejection from the aircraft is to remove the adhesive paper band from the rotor blades.

The minimum launching altitude is 150 ft. At this altitude, the speed of the launching aircraft should not exceed

150 knots. At greater altitudes, aircraft speed may be increased, approximately, 1 knot for each altitude increase of 3.5 ft. The maximum allowable speed is 250 knots at an altitude of 500 ft. or greater.

The buoy may be launched from altitudes greater than 500 ft. but speeds exceeding 250 knots could damage the descent-retarding mechanism and result in distruction of the buoy at impact. There are two steps in the launching procedure:

1. Remove paper band from the rotor blades
2. Launch the buoy with rotor blades held closed against the case, and with rotor end first.

When thrown through a hatch, the buoy should be propelled with sufficient force to clear the slip stream of the aircraft before rotor blades open.

Maintenance

In respect to the experimental models, maintenance will be concerned with inspection and reconditioning of the equipment that has been dropped in the evaluation tests. Such equipment has been subjected to large forces and should be disassembled and given detailed inspection for signs of physical damage. In the event that no damage is evident, certain parts will require reconditioning after use. Such parts include, the gas generator, transmitter switch and the rotor-release mechanism. The usual maintenance procedure which was followed in handling the two development models X-1 and X-2 is given below in the order of

the sequence of operations.

1. Detach base ring by removing the four round-head screws which are accessible through holes in the base ring lower flange. The base ring may be withdrawn from the extension of the case tubing. Since these screw holes penetrate into the lower case, any leakage of consequence will be made evident by drainage from the case through the screw holes.
2. Remove screws from gas generator bellows flange and detach bellows. The ring nut on the metering tube and the ring nut on the water-inlet tube are then removed in order to detach the inner generator partition from the base plate.
3. Remove generator base plate screws and check ventilation conditions of the work room. If ventilation is not uncommonly effective, take the buoy outside and remove base plate with the attached cooling fins. Use caution to avoid deforming base plate. The residue from the calcium carbide reaction is removed with the aid of a flat blade and the generator side walls cleaned sufficiently to permit withdrawal of the generator partition.
4. Removal of the partition opens gas passages to the drift float which is then deflated, either by

exerting pressure on the float or by using a small pump or aspirator attached by means of the generator tubing-adaptor.

5. Generator parts should be washed with water and then immersed in dilute nitric acid until stains are removed from aluminum.

6. Remove attachment screws from the top cover-plate including the screws in the release mechanism cover. Withdraw transmitter chassis and top plate as an assembly.

7. Remove 12 screws in case junction flange and separate upper and lower cases far enough to reach line-multiplug which is stowed in lower case section. Remove tape and disconnect plug. Care should be exercised in initially separating the case sections to avoid bending the gas and trigger-rod tubes which have O-ring sealed slip-joints at case junction.

8. Detach transmitter switchetts from operating mechanism by first removing the two 1/8" bolts which run through switch bodies and aluminum mounting brackets. Remove two flat-head screws which extend from the outside, through the case flange to the operating mechanism case. Remove 4 screws which extend from the outside through the upper case top ring to attach the rotor-release

housing. Remove rotor-release housing, connecting tube and transmitter switch case as a unit.

9. Disassemble both mechanisms and wash all parts with fresh water, dry, coat with light oil and reassemble. Apply a coating of sealing compound to the edges of the switch mechanism gasket and around the tube where it enters the housings.

10. Use small air pump or aspirator to completely deflate the drift float and remove any water that might be present. Too rapid generator action will vaporize some of the water which enters the generator and this water vapor will condense in the gas lines and in the drift float. If water is present in any quantity, examine generator water reservoir for leaks.

11. Remove the two knurled manifold cap screws. Blow out the passages between drift float stems and manifold fittings. If there is any indication of corrosion on brass float-stems, flush manifold fittings and tubing with fresh water. Dry out all gas passages, inspect rubber gaskets and replace if necessary, apply light oil to threads of cap screws and reassemble. Check system for leaks.

12. In case there is any indication of leakage in the lower case, or if the batteries are exhausted, the batteries, packing strips, pads and separator

tube should be removed. Remove aluminum offset retaining-strip which serves as a hold-down. Remove A battery packing strips from the two sides of the pack which are at 90° from the packing strip surrounding the aluminum tube. Withdraw A battery pack and strip opposite tubes simultaneously. Remove phenolic plastic separator tube by using puller which fits the two ¼" holes near the upper edge. Remove B battery hold-down clips, aluminum 2-piece ring and sponge-rubber ring. Withdraw wood wedges and packing strips and remove B battery packs. Assembly of the batteries in the case is performed in the reverse order. The factory-built B battery packs are taped in two groups of 5 units each and one group of four. Two groups are series connected and all but one unit of the remaining group are series connected. The groups are series connected to make a B battery of 13 units and a transistor battery of 1 unit. Leads, about 18" long are connected to the female side of a line junction-plug. Leads between groups are made long enough to permit individual installations in the lower case. All B batteries are installed with connection leads on the side toward the case. Packing strips and wedges are then put in position, followed by the installation of the separator tube,

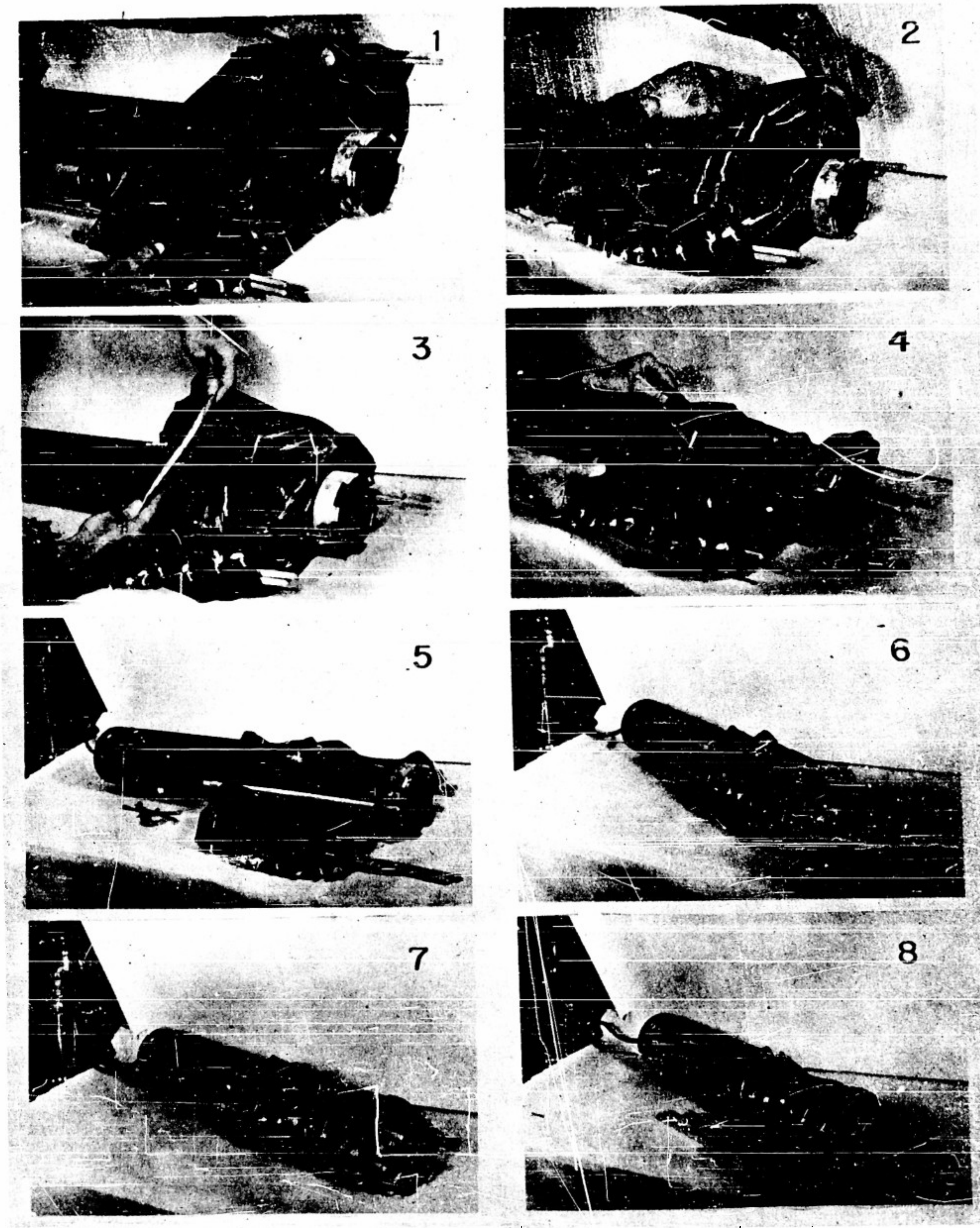
A battery pack and packing strips, rubber pads, rings and hold-downs.

13. Assembly of the reconditioned parts starts by joining the two cases. Entering the trigger-rod tube into the slip-joint in the switch-housing is facilitated by first entering the lower trigger-rod which will act as a guide as the cases are brought together. Make certain that match marks on upper and lower cases are in alignment. When coupling screws have been installed and tightened, flange and screwheads are coated with sealing compound. Coat also the heads of the screws which attach the transmitter switch mechanisms and the rotor-release housing.

14. Using tubing adaptor in the gas generator case, exhaust air from drift-float. Avoid building up a large pressure difference which would make manipulation of the float difficult. Stretch both sections of float from lacings to diametrically opposite web in order to remove unwanted folds in the float fabric. Treating both halves of the float in the same manner, fold top and bottom semicircular pieces toward the center then make longitudinal folds either side of the lacing strip and of the fabric strip. Install float covers and clamp temporarily with hose clamp.

15. Place 140 grams (approximately 5 oz.) of calcium carbide in gas generator screen and assemble generator to case. Apply a coating of sealing compound to all screw heads and to the edge of generator base plate.
16. Assemble dye-marker plate, trigger-foot and crash plate in base collar. Insert lower trigger-rod in tube. Apply sealing compound to threads of 4 screw holes in case end-piece. Install base collar assembly. Coat 4 attachment screws with sealing compound before putting them in place.
17. Install upper trigger-rod and cock rotor-release plunger. Insert transmitter assembly and rotor-release cover. Apply sealing compound to all joints and screw heads.
18. Tape rotor blades open by running tape across spring handles from one blade to another. Put spring loaded cap in place and hold in position by using some form of light-duty press or drill press. Place spring retainer in groove formed by interlocking ears of rotor cap and case ring. Bring ends of spring ring together and force locking hook through holes in the ends. Install float cover retaining band and rotate until free end is under tab of spring retainer. Fold rotor blades down against case and tape in position with adhesive paper tape.

METHOD OF FOLDING DRIFT-FLOAT



LIST OF CONSTRUCTION DRAWINGS

CASE

Assembly	C-1
Upper Tube Assembly	C-2
Lower Case Assembly	C-3
Top Case Ring	C-4
Top End Plate	C-5
Float Shields	C-6
Lower Flange, Upper Case	C-7
Top Flange, Battery Case	C-8
Base Collar Assembly	C-9
Battery Pack Details	C-10
Battery Pack Details	C-11
Battery Pack Details	C-12

RELEASE MECHANISM

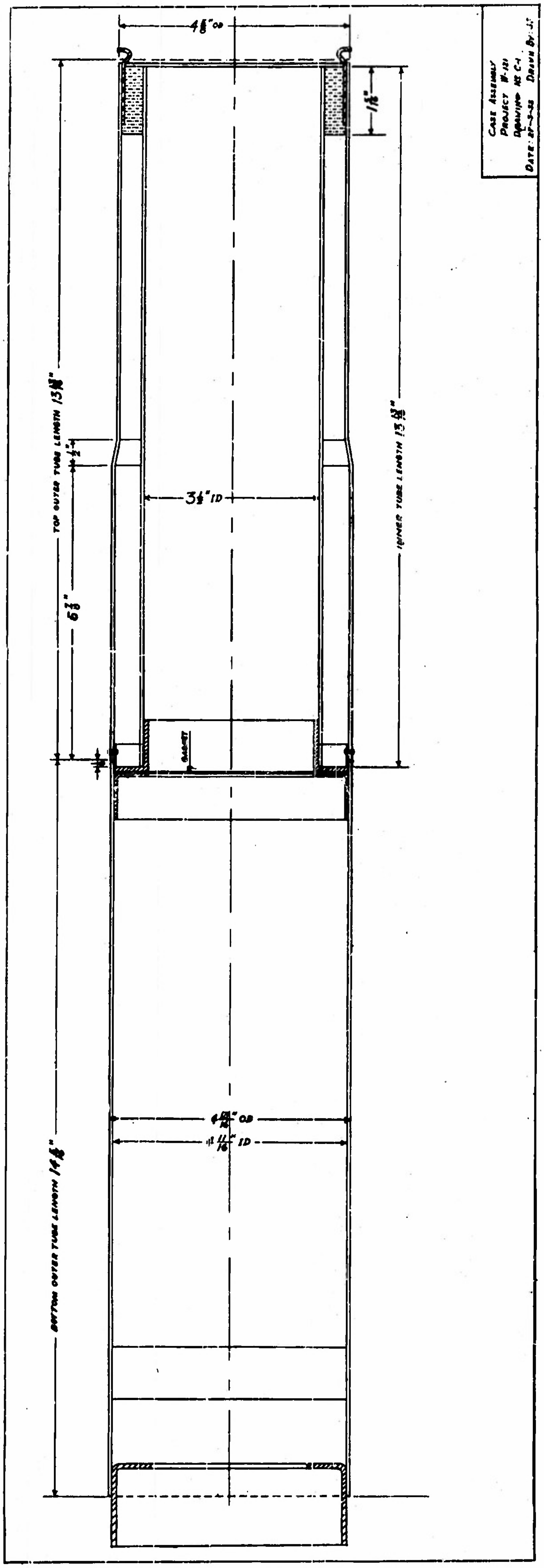
Rotor-Release Assembly	R-1
Rotor-Release Body Details	R-2
Rotor-Release Details	R-3
Release Cover	R-4
Float-Cover Retainer	R-5

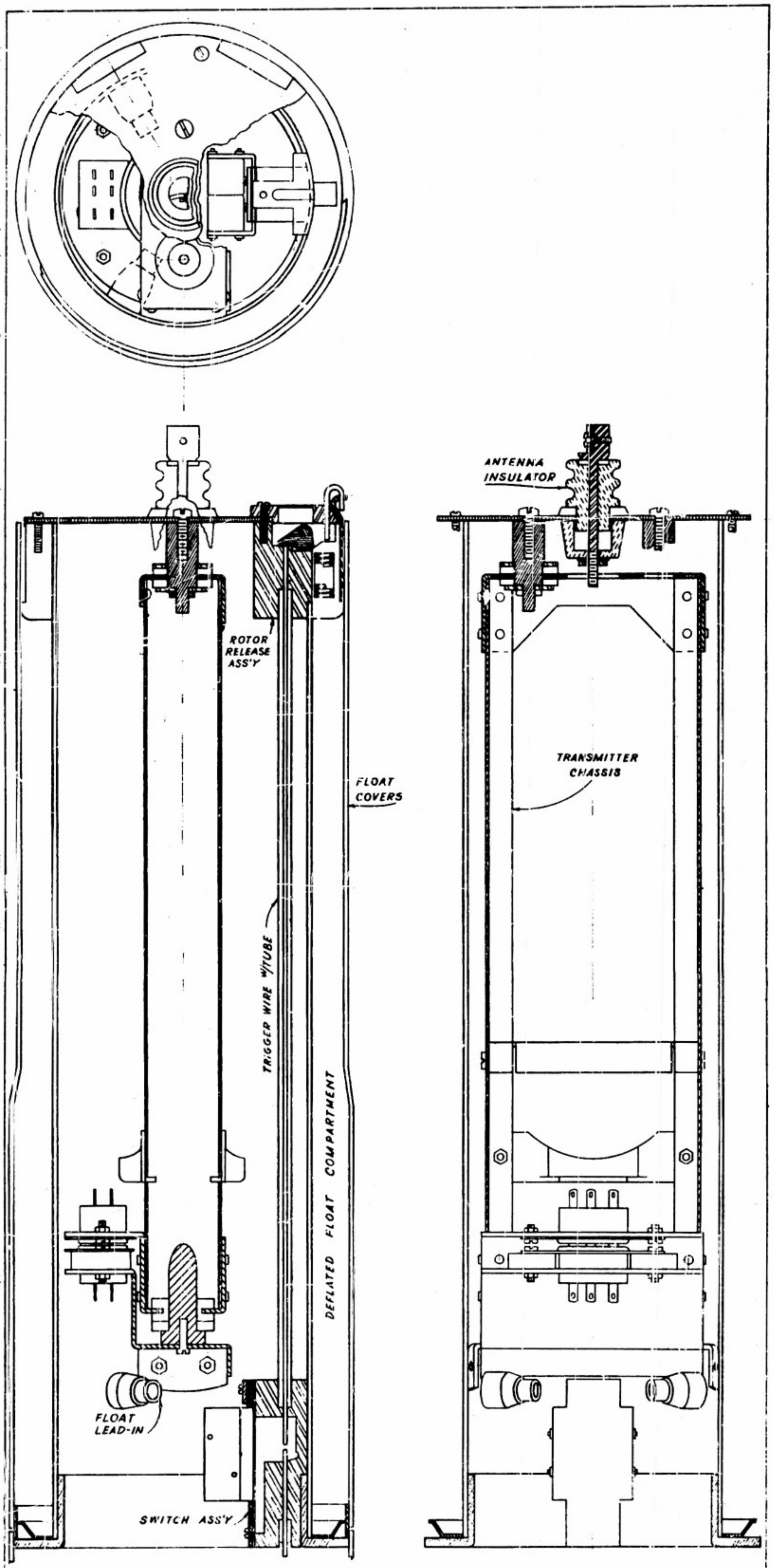
TRANSMITTER

Chassis	T-1
Case Wiring Diagram	T-2
Switch Assembly	T-3
Switch Body	T-4
Cover Plate	T-5
Switch Details	T-6
Shock Mount Details	T-7
Lower Mounting Bracket	T-8
Keyer Switch	T-9
Keyer Drive	T-10
Buoy Light	T-11

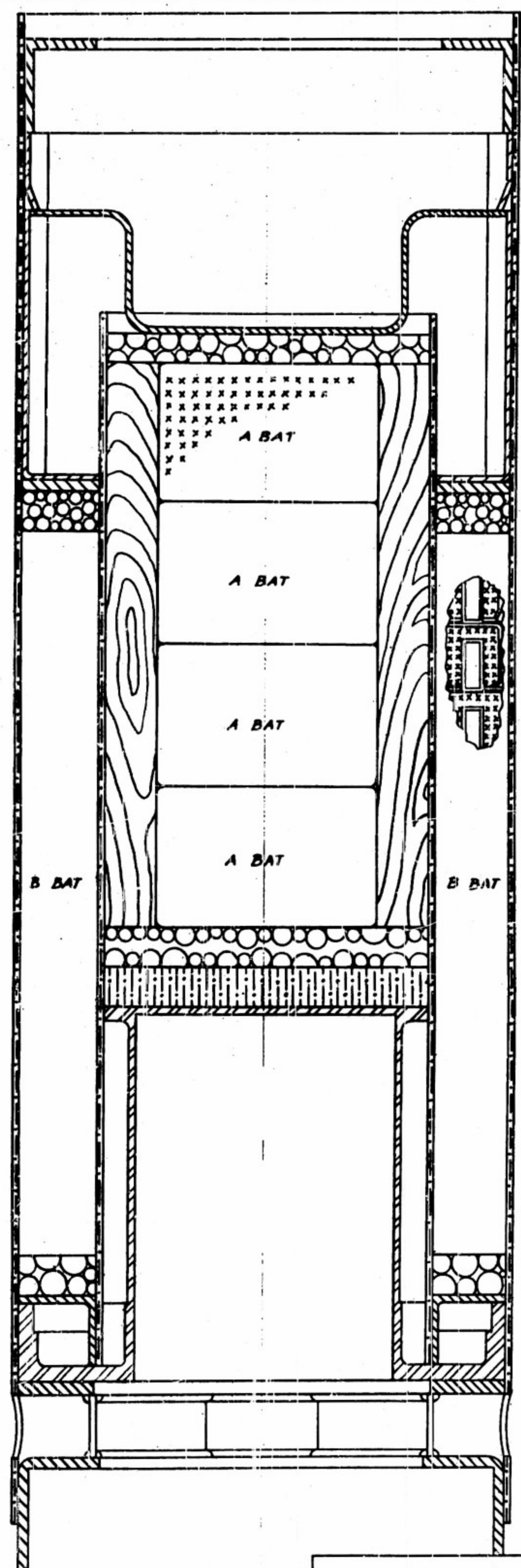
GAS GENERATOR

Assembly	G-1
Details	G-2
Gas Tight Coupling	G-3
Gas Coupling Layout	G-4
Case Details	G-5
Bottom Plate	G-6
Fins	G-7
Partition	G-8
Reservoir	G-9
Details	G-11
Details	G-11A
Gas Generator Outlet	G-12
Base Ring	G-13

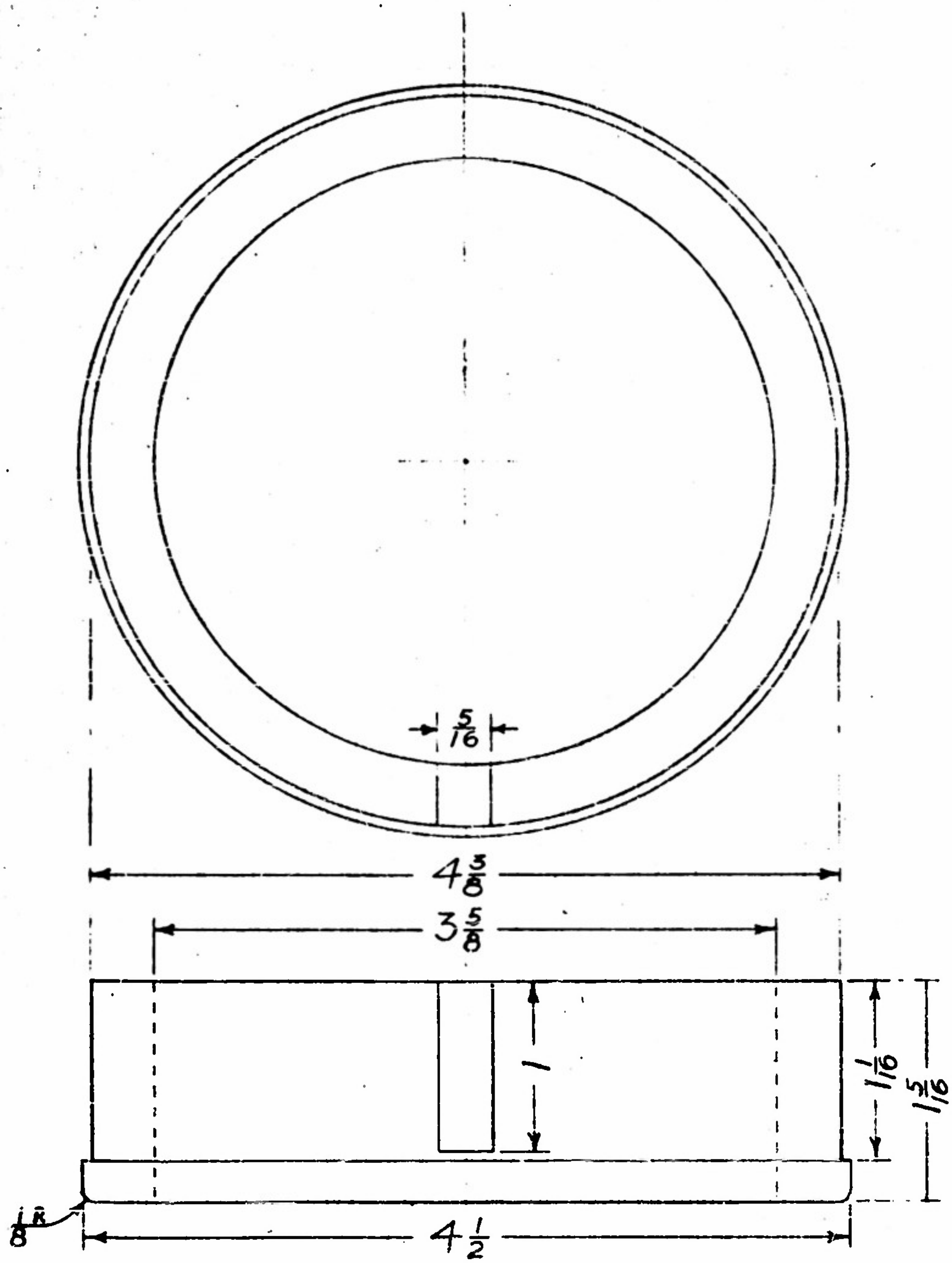

CASE ASSEMBLY
PROJECT W-121
DRAWING NO C-1
TOP OUTER TUBE LENGTH
INNER TUBE LENGTH
3½" ID
GASKET
BOTTOM OUTER TUBE LENGTH



UPPER TUBE ASSEMBLY
PROJECT W-121
DRAWING No C-2
DATE: 20-1-53 DRAWN BY: JF

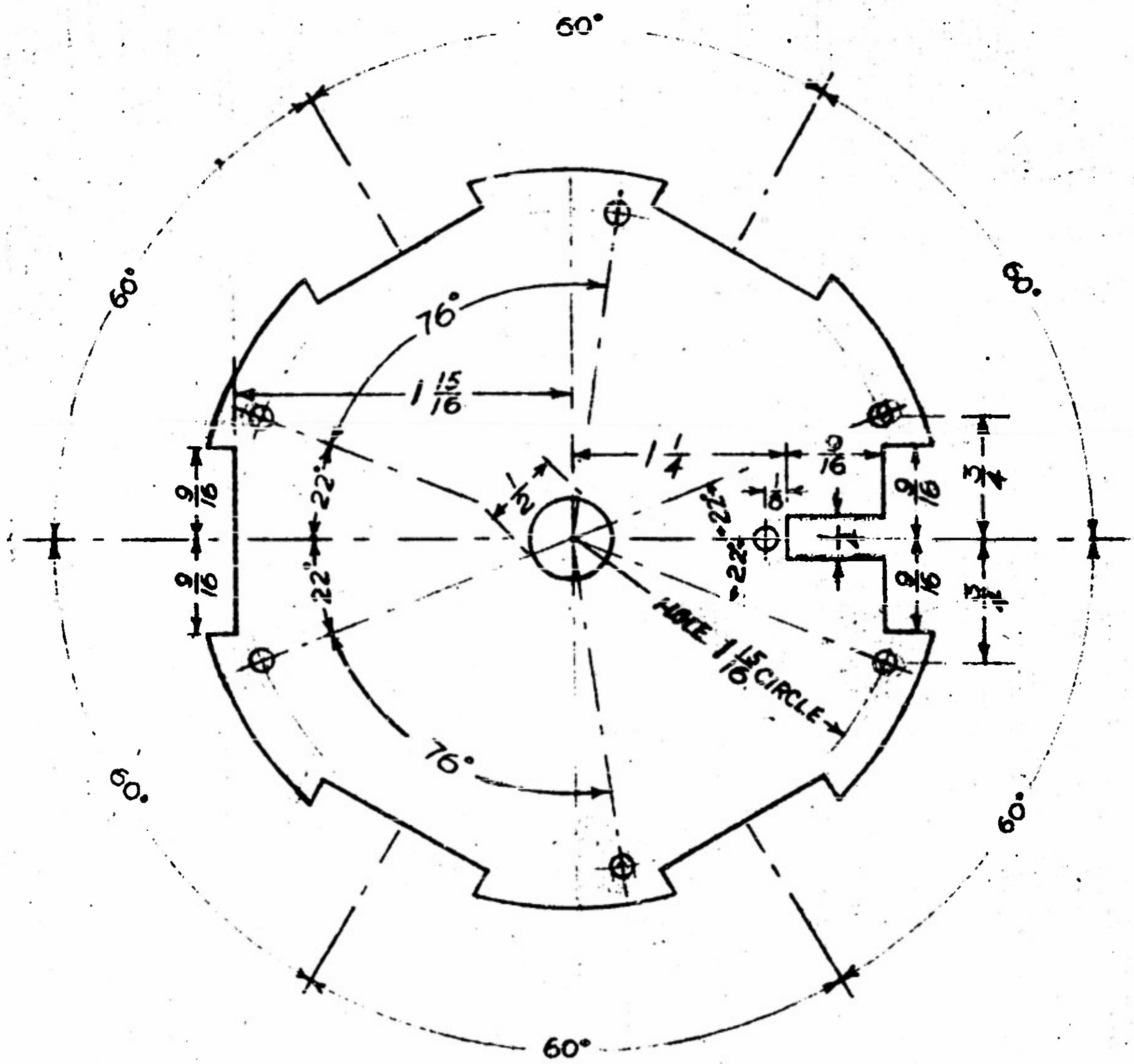


LOWER CASE ASSEMBLY
PROJECT W-121
DRAWING Nº C-3
DATE 28-12-53 DRAWN BY JF



MATERIAL: MICARTA
PUSH FIT ON TUBING
SCALE: FULL SIZE

TOP CASE RING
PROJECT W-121
DRAWING Nº C-4
DATE: 28-10-53 DRAWN BY: JF



7 HOLES AS INDICATED

FOR TOP PLATE: INTERCHANGEABLE CLEARANCE

No 6 SCREW

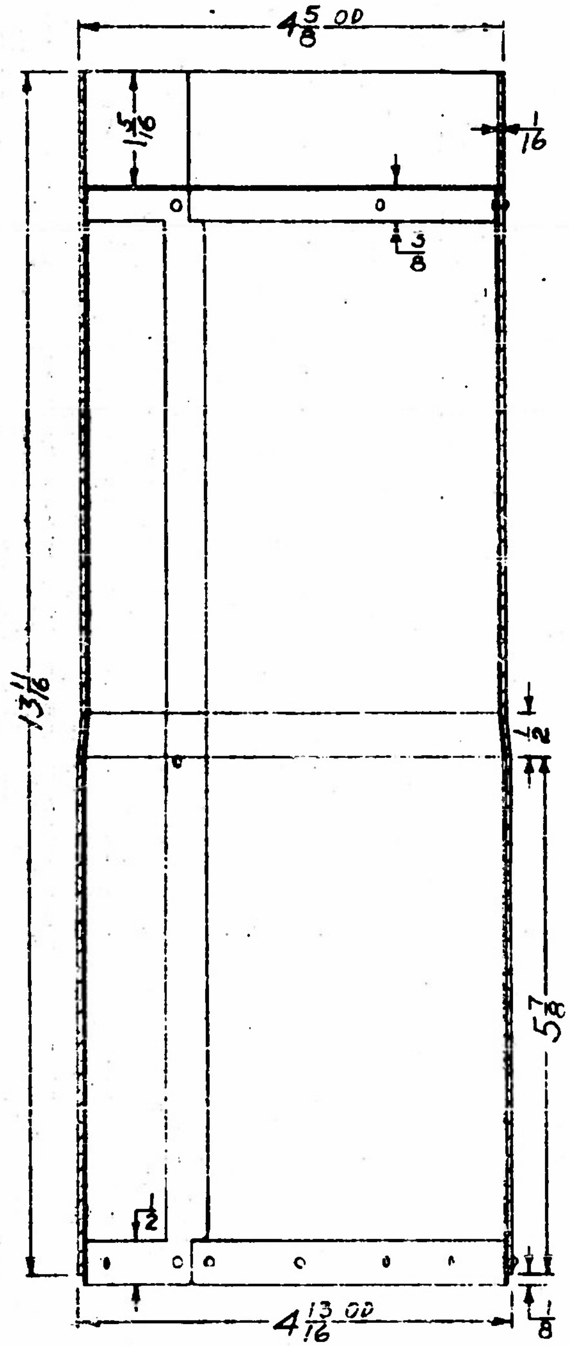
FOR TEMPLATE:

No 36 DRILL

USE ALUMINUM 24 ST $\frac{1}{16}$" THICK

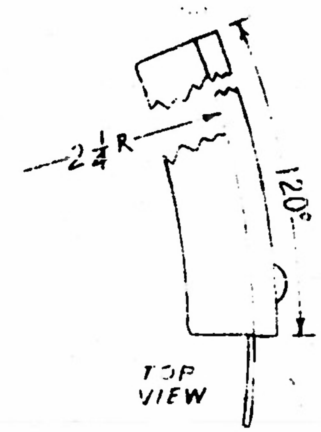
SCALE: FULL SIZE

TOP END PLATE -AND- HOLE TEMPLATE	
PROJECT	W-121
DRAWING	No C-5
DATE 23-6-53	DRAWN BY: JF

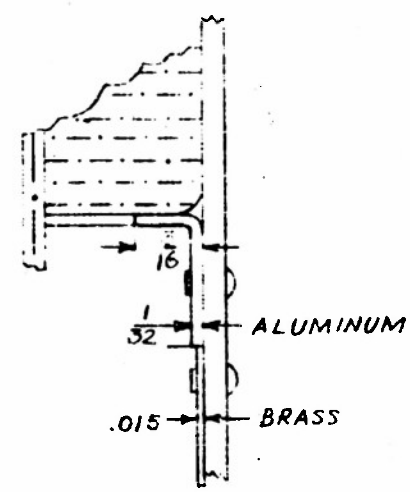


CROSS SECTION OF
OVERLAPPING COVERS
HALF SIZE

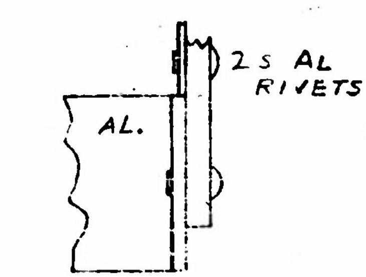
MAKE 3
COVER MATERIAL: FABRIC BASE BAKELITE



TOP
VIEW

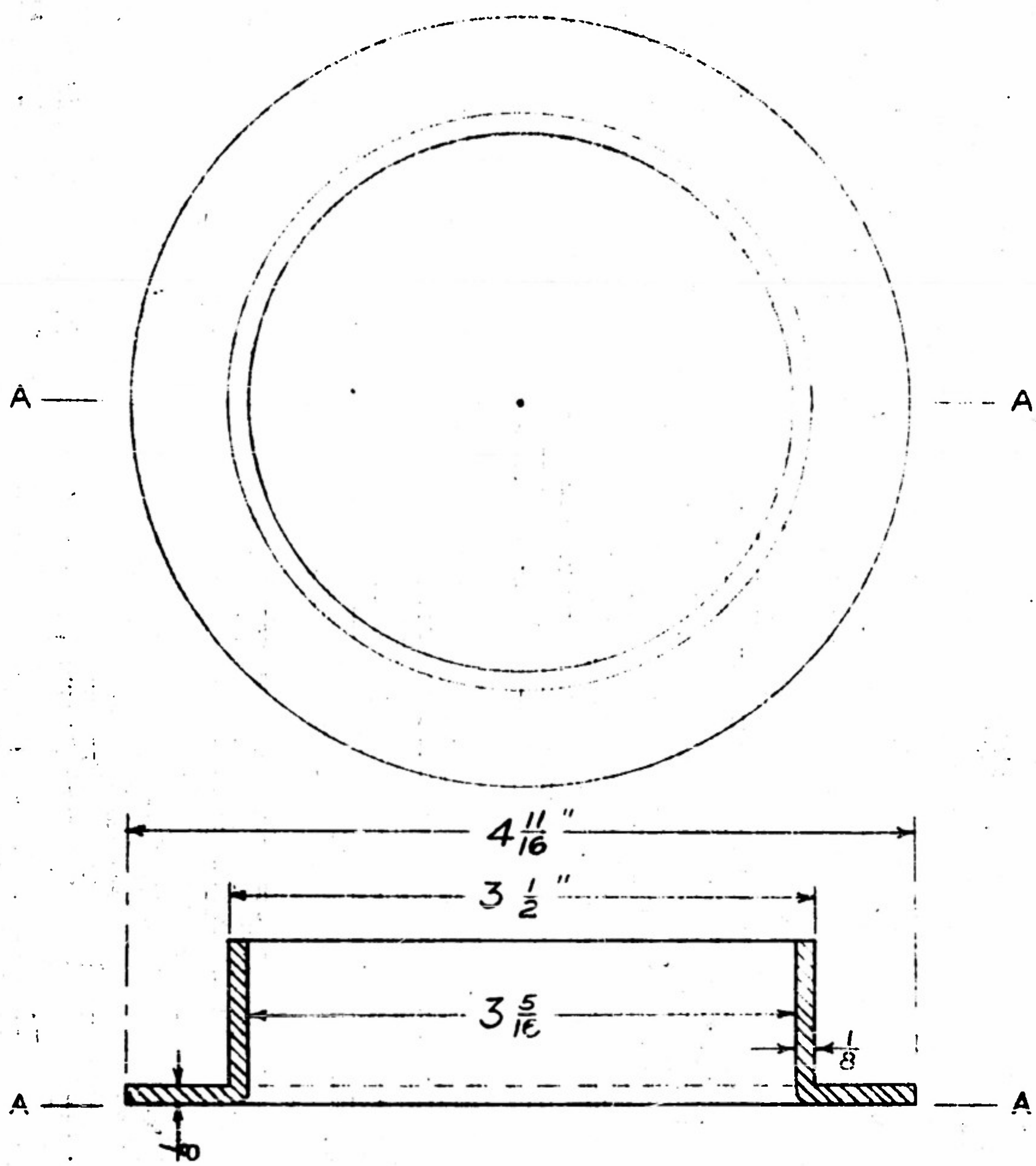


UPPER FLANGE



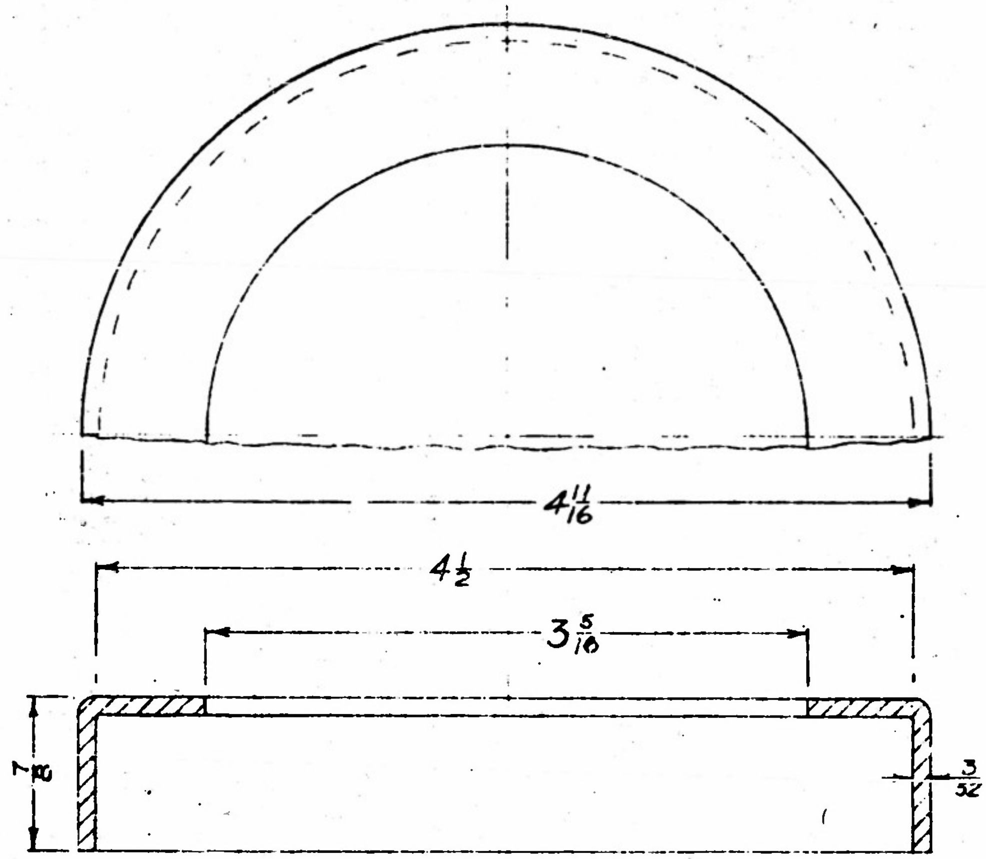
LOWER FLANGE
DOUBLE SIZE

FLOAT SHIELDS
PROJECT W-121
DRAWING No C-6
DATE: 2-3-54 DRAWN BY J.F.



USE 24 ST AL.
SCALE: FULL SIZE

LOWER FLANGE, UPPER CASE
PROJECT W-121
DRAWING № C-7
DATE 18-6-53 DRAWN BY J F



MAKE 1

61 S ALUMINUM IF FORMED

24 ST_3 " IF MACHINED

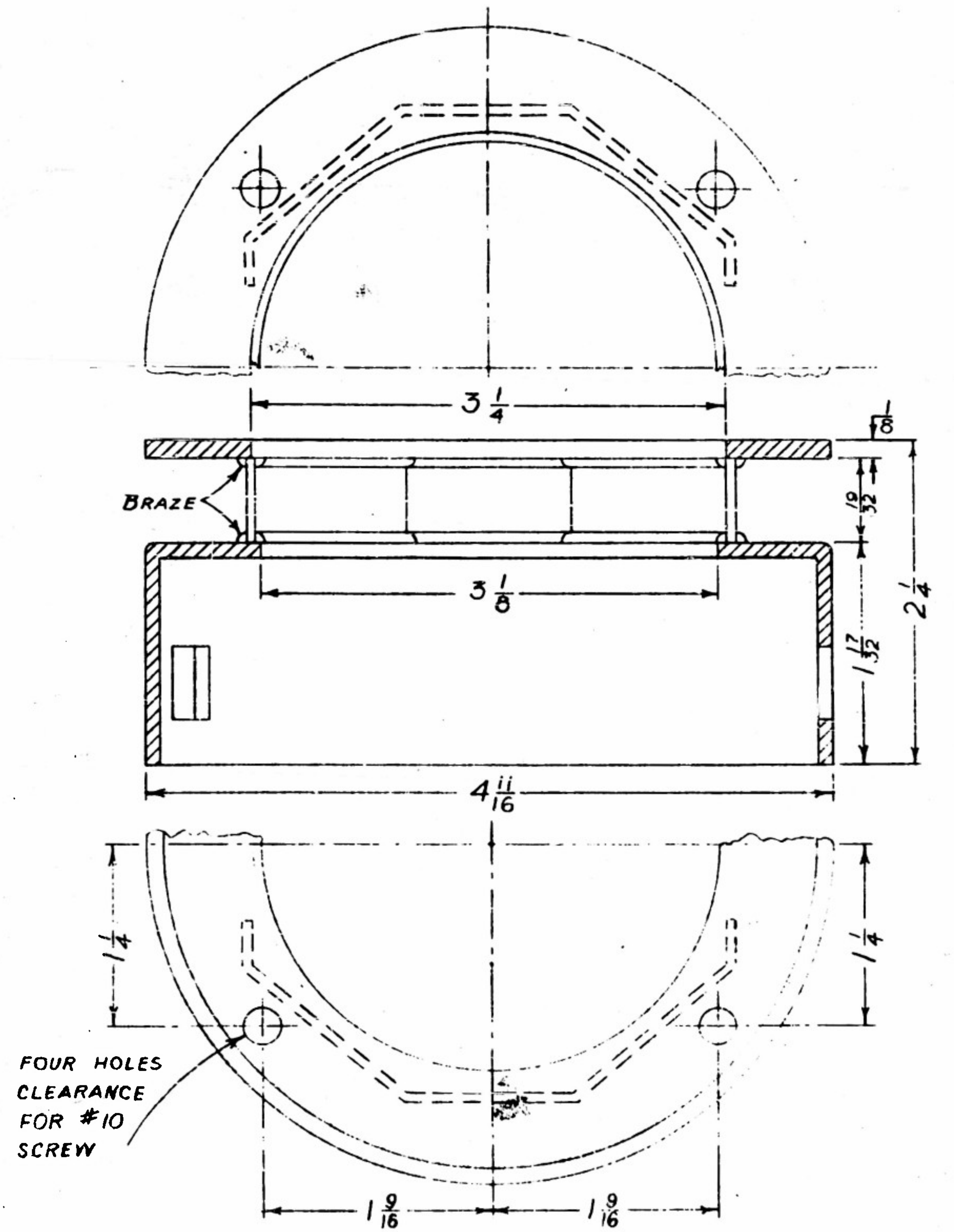
SCALE: FULL SIZE

TOP FLANGE, BATTERY CASE

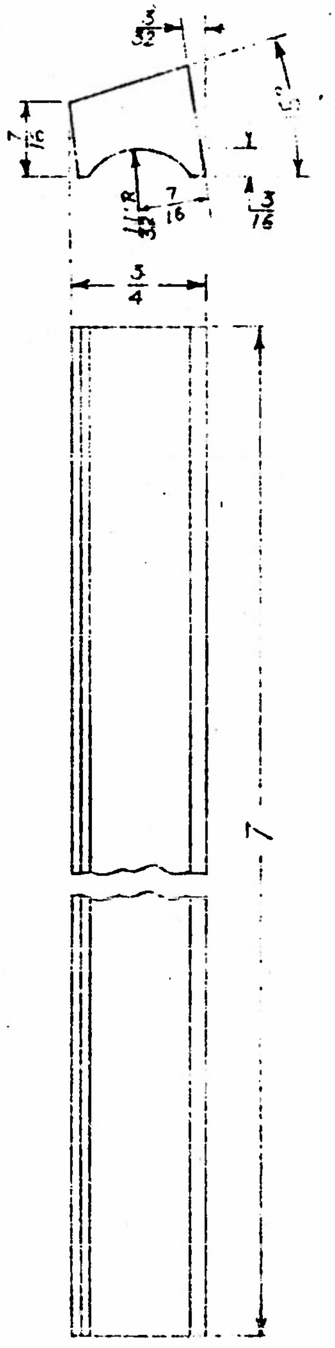
PROJECT W-121

DRAWING Nº C-8

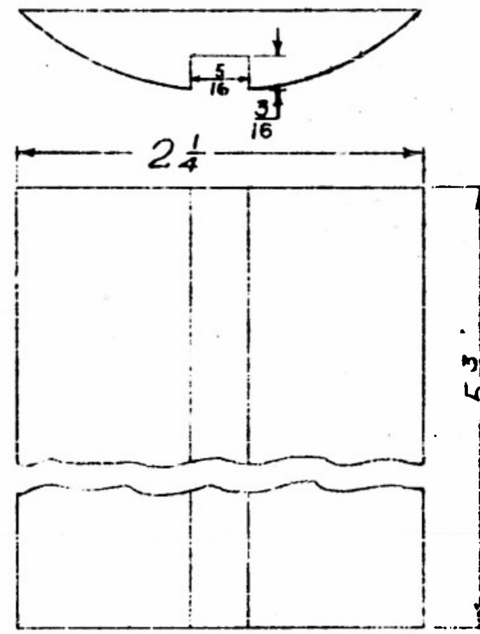
DATE: 1-5-54 DRAWN BY J.F.



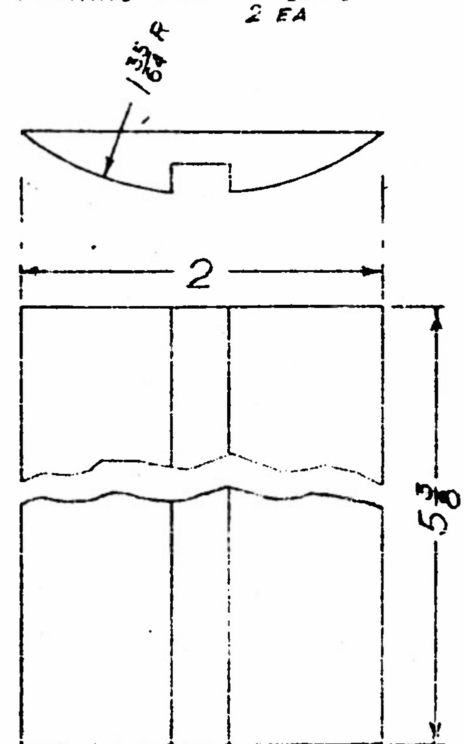
BASE COLLAR ASSEMBLY
PROJECT W-121
DRAWING Nº C-9
DATE: 6-11-53 DRAWN BY JF



SPACERS FOR "B" BATS
6 EA



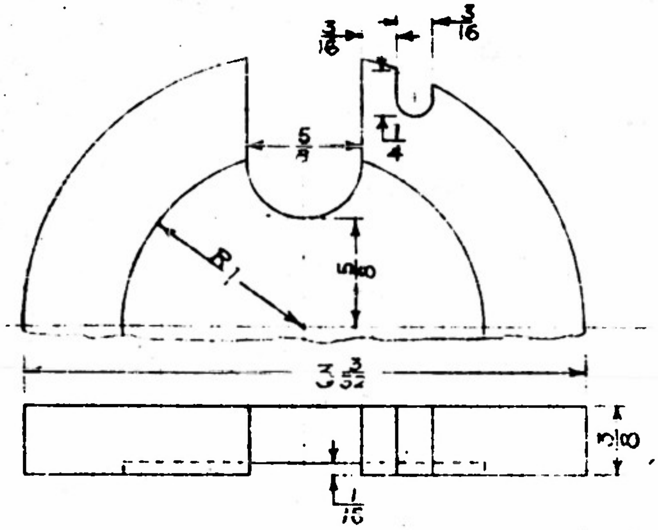
PACKING FOR "A" BATS
2 EA



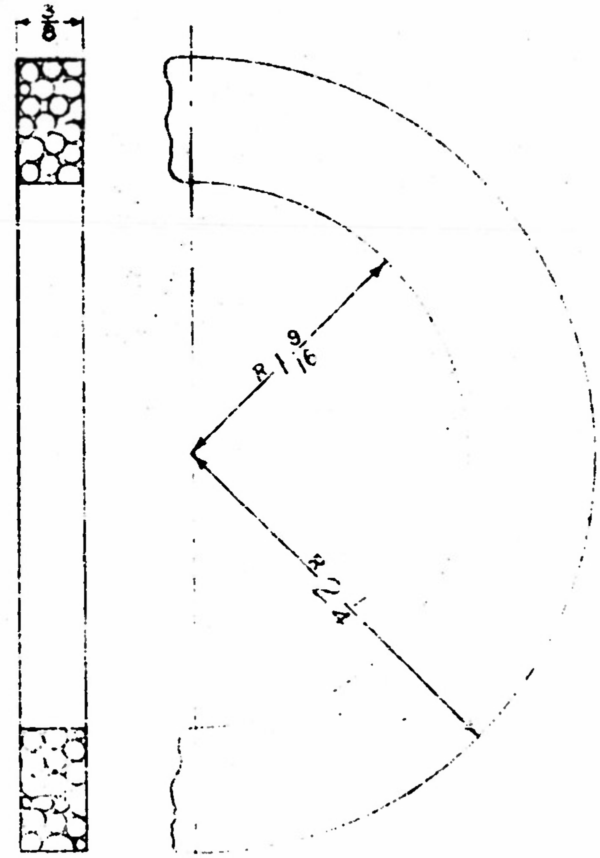
PACKING FOR "A" BATS
2 EA

MATERIAL: WOOD
SCALE: FULL SIZE

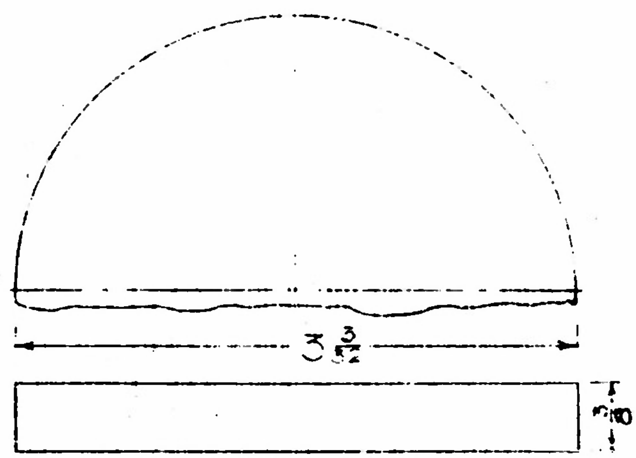
BATTERY PACK DETAILS	
PROJECT W-121	
DRAWING Nº C-10	
DATE 29-12-53	DRAWN BY J F



MICARTA DISC
1 EA



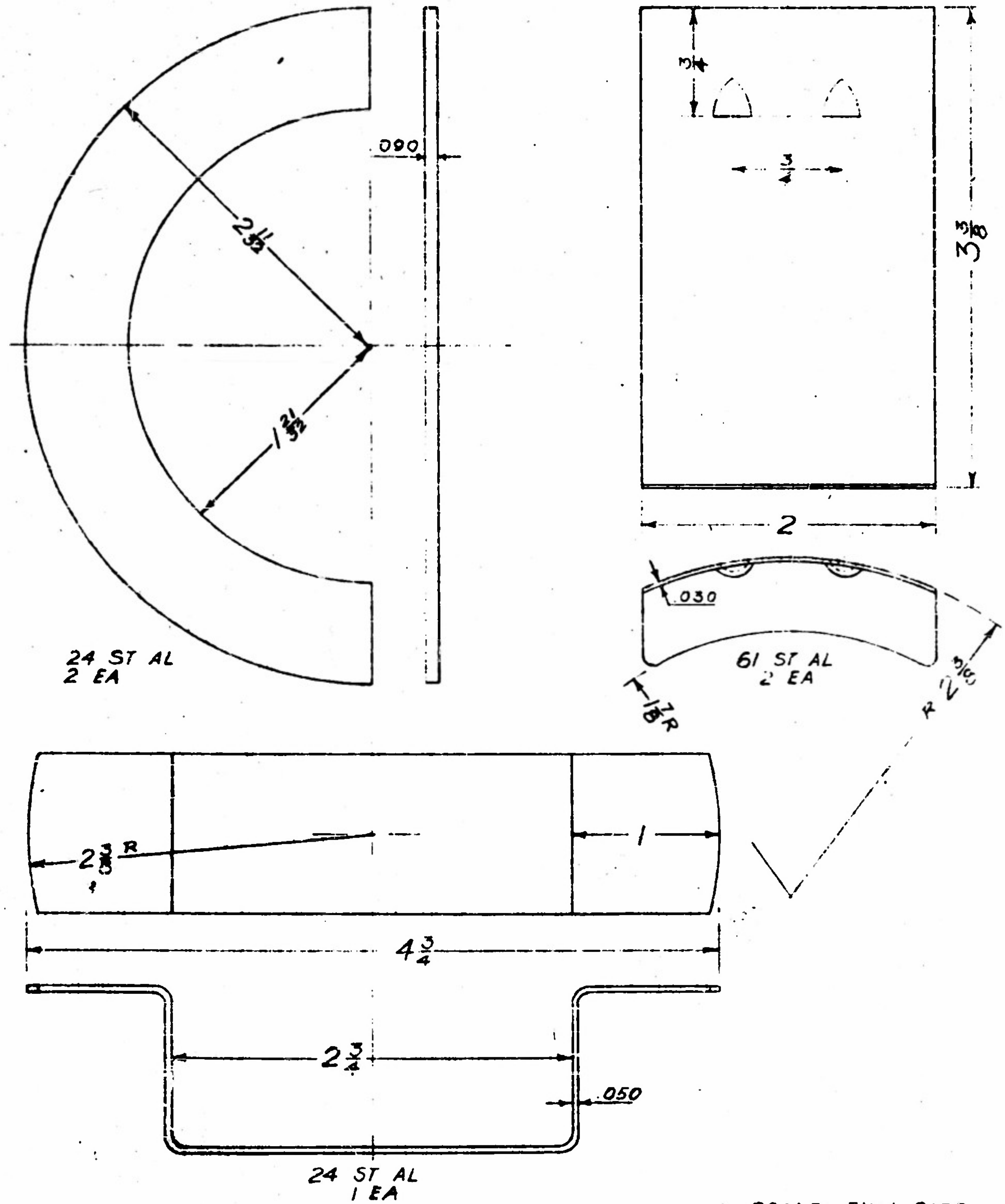
SPONGE RUBBER RING
1 EA



SPONGE RUBBER PAD
1 EA

SCALE FULL SIZE

BATTERY PACK DETAILS
PROJECT W-131
DRAWING NO 011
DATE 30-12-53 DRAWN BY JF



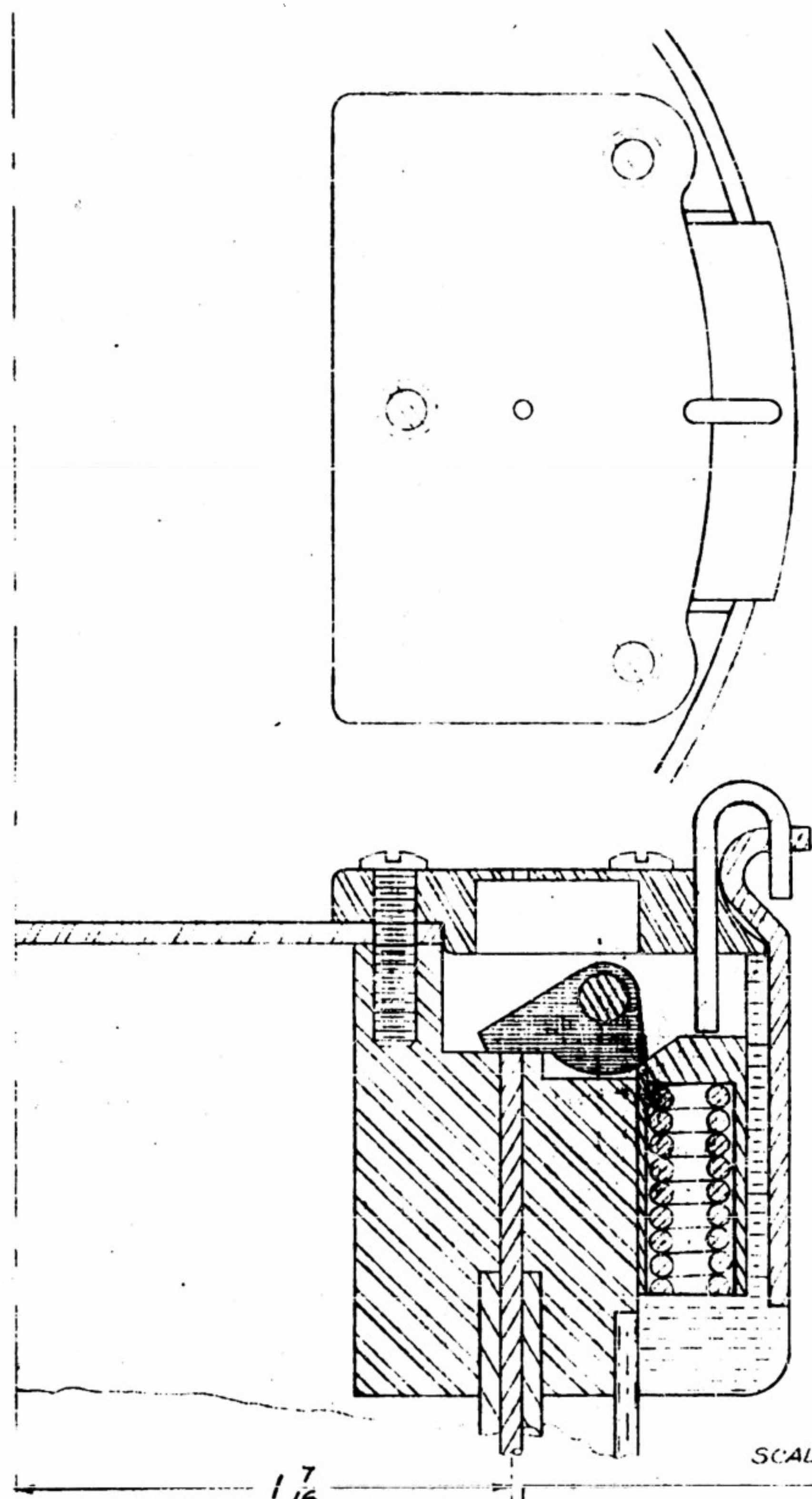
SCALE: FULL SIZE

BATTERY PACK DETAILS

PROJECT W-121

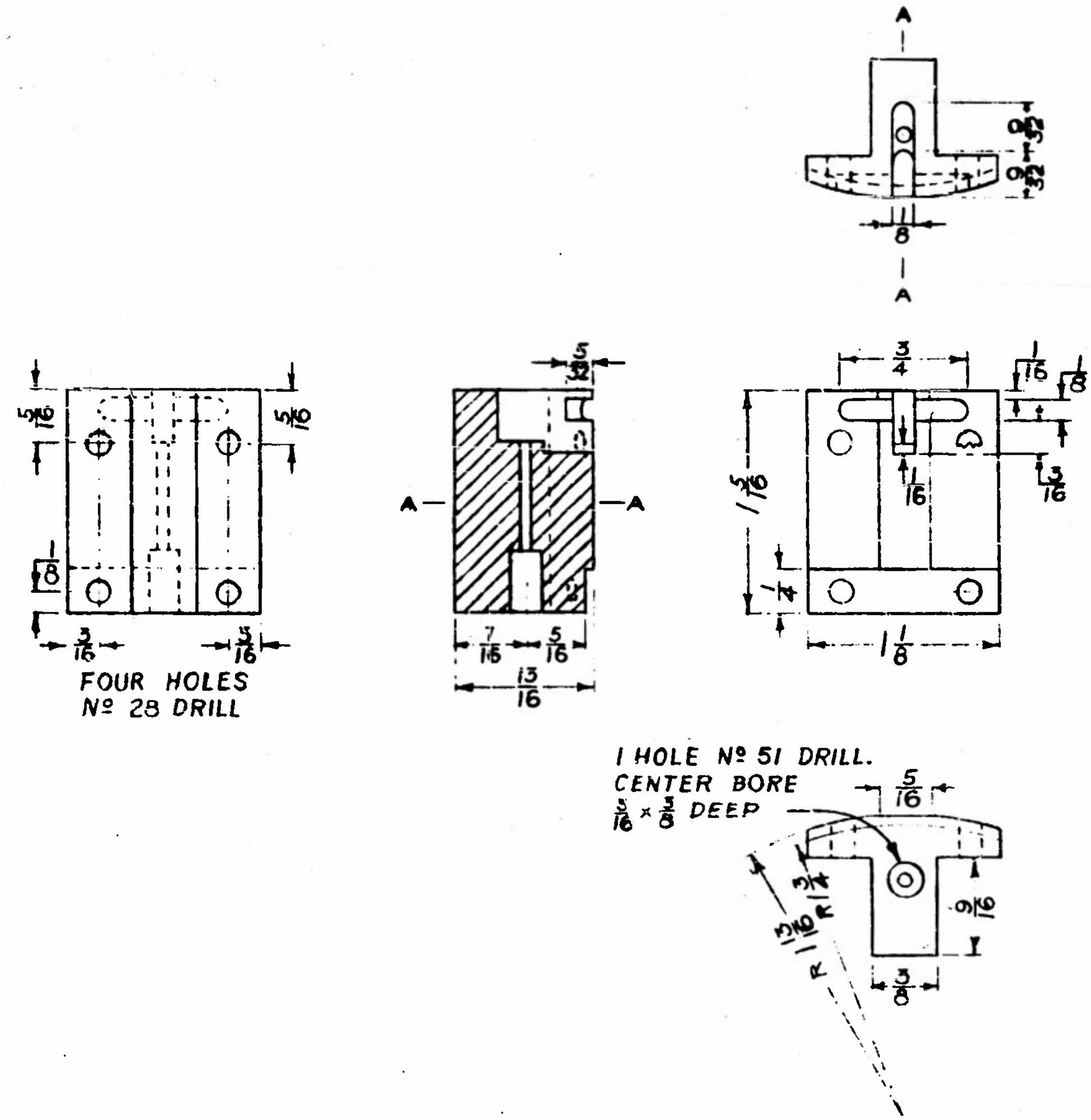
DRAWING Nº C-12

DATE 6-1-54 DRAWN BY: JF



SCALE: 2-1

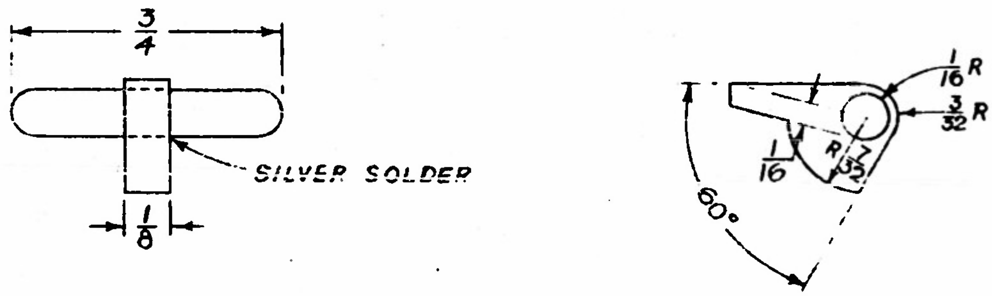
ROTOR RELEASE ASS'Y
PROJECT W 121
DRAWING Nº R-1
DATE 30-6-53 DRAWN BY JF



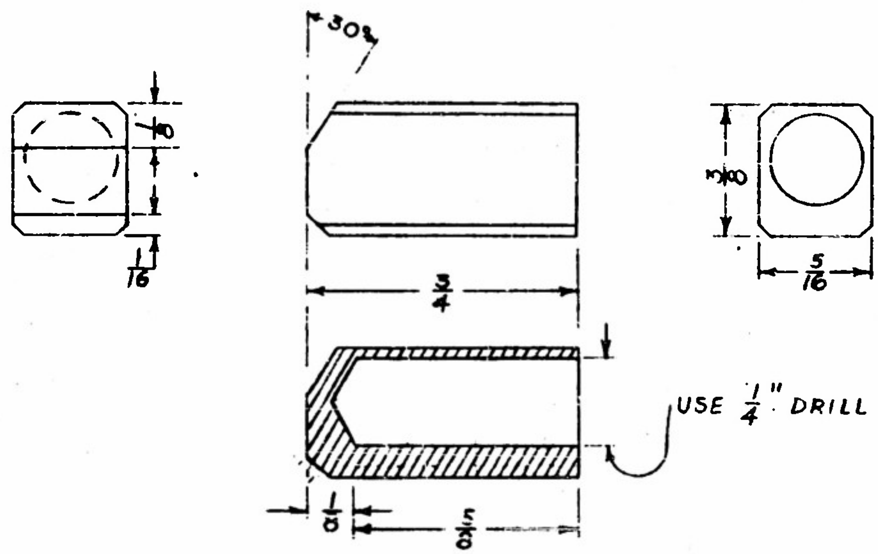
MATERIAL 24 ST ALUMINUM
SCALE FULL SIZE

ROTOR RELEASE BODY DETAILS	
PROJECT W-121	
DRAWING Nº R-2	
DATE 12-11-53	DRAWN BY JF

LATCH

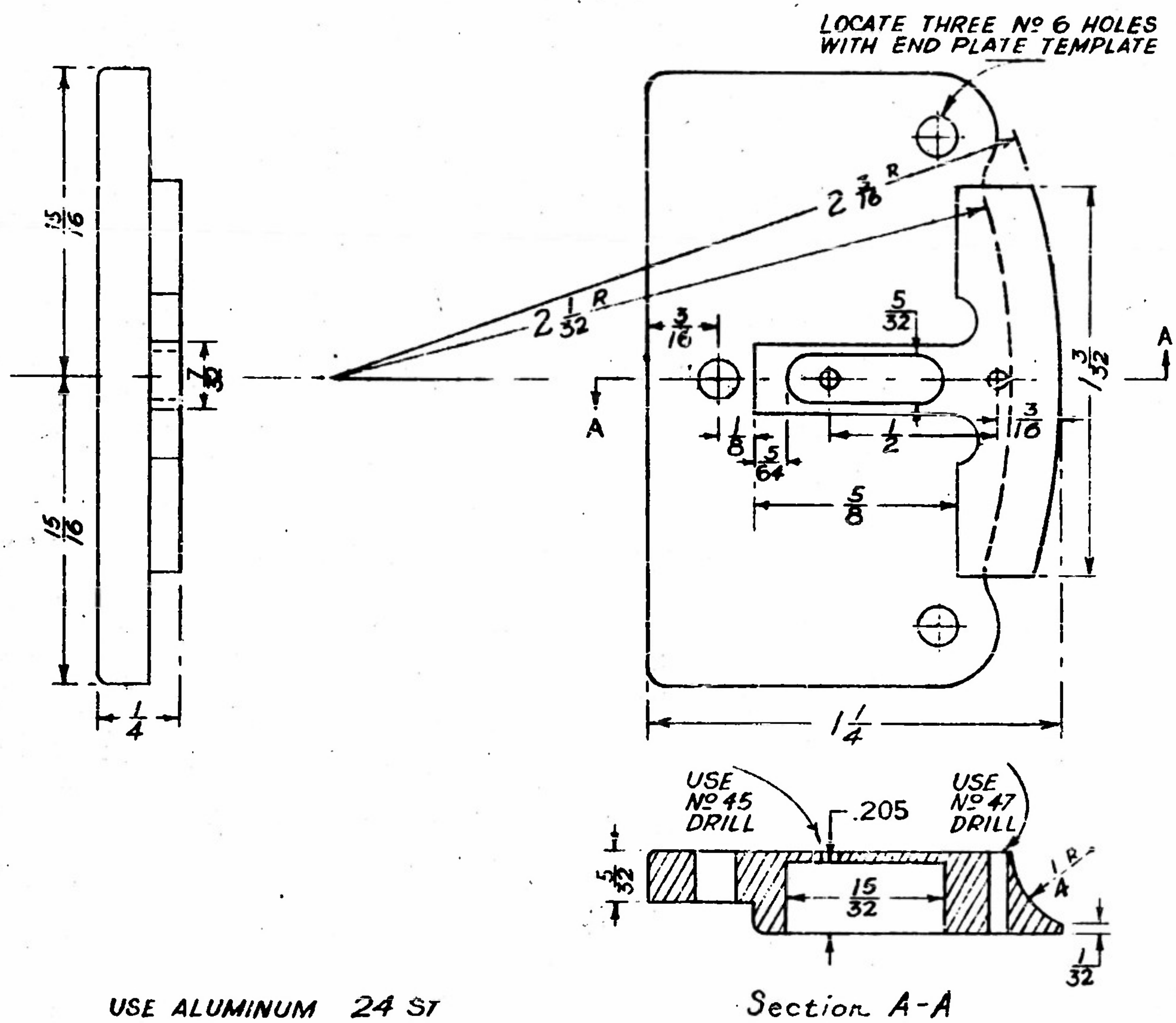


PLUNGER



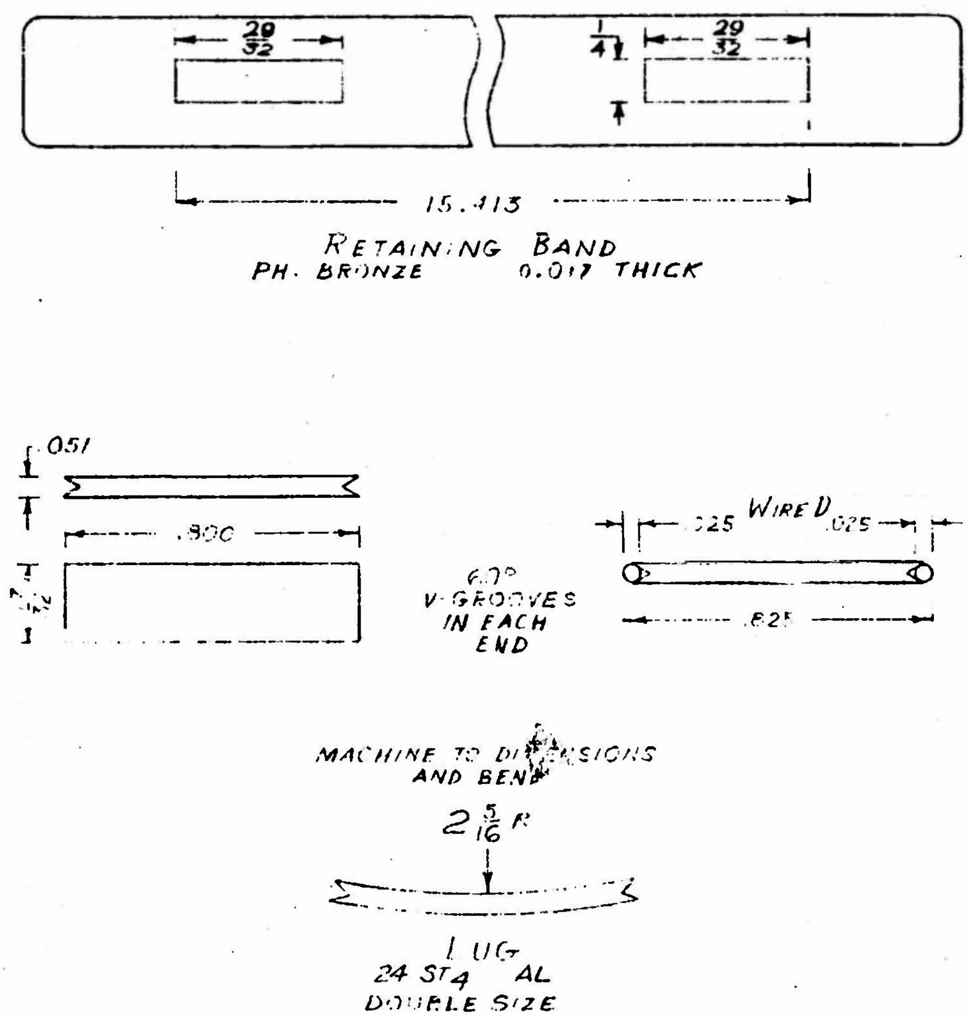
MATERIAL: STAINLESS STEEL
SCALE: 2-1

ROTOR RELEASE DETAILS	
PROJECT	W-121
DRAWING	Nº R-3
DATE: 30-10-53	DRAWN BY JF



SCALE 2-1

RELEASE COVER
PROJECT W-121
DRAWING Nº R-4
DATE 25-6-53 DRAWN BY J F

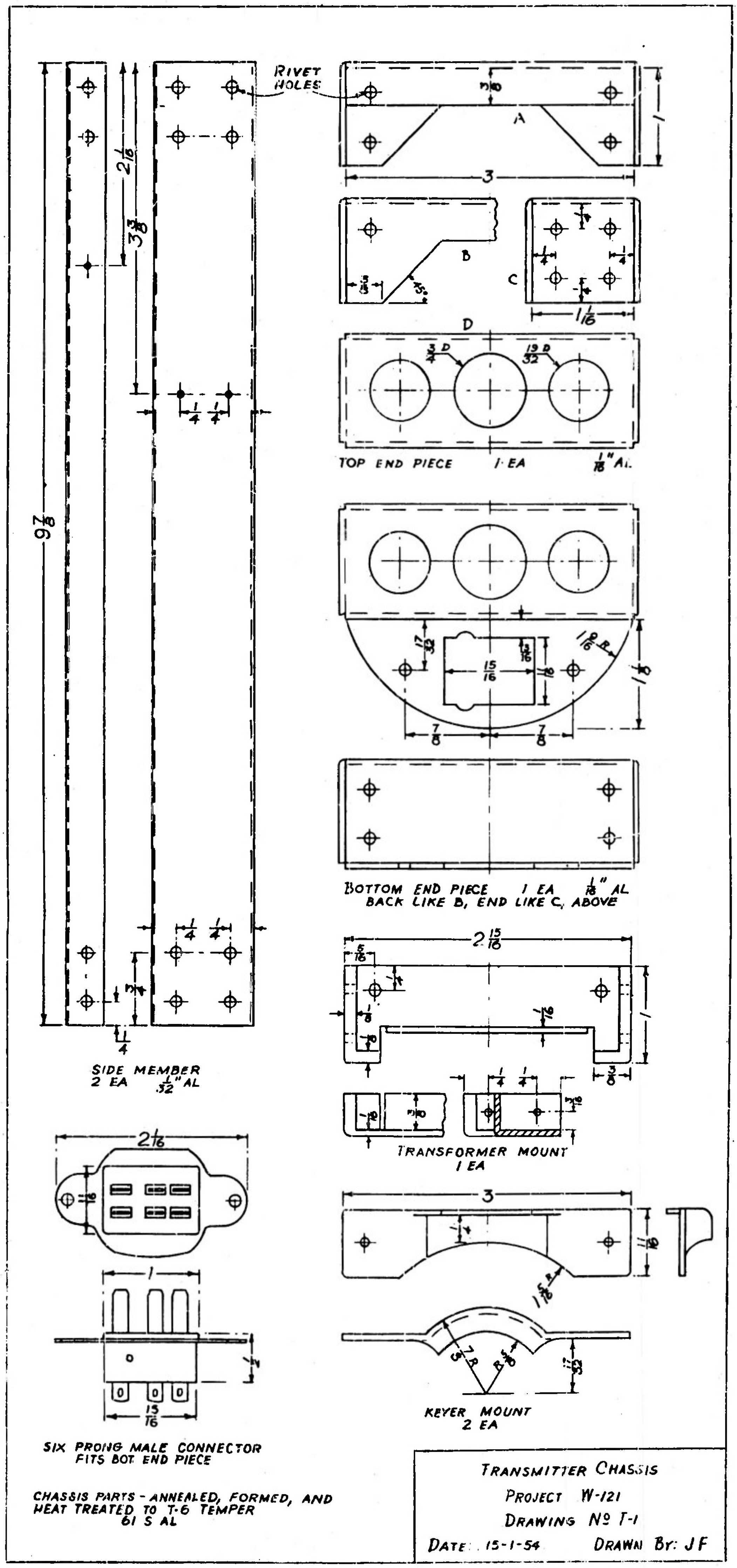


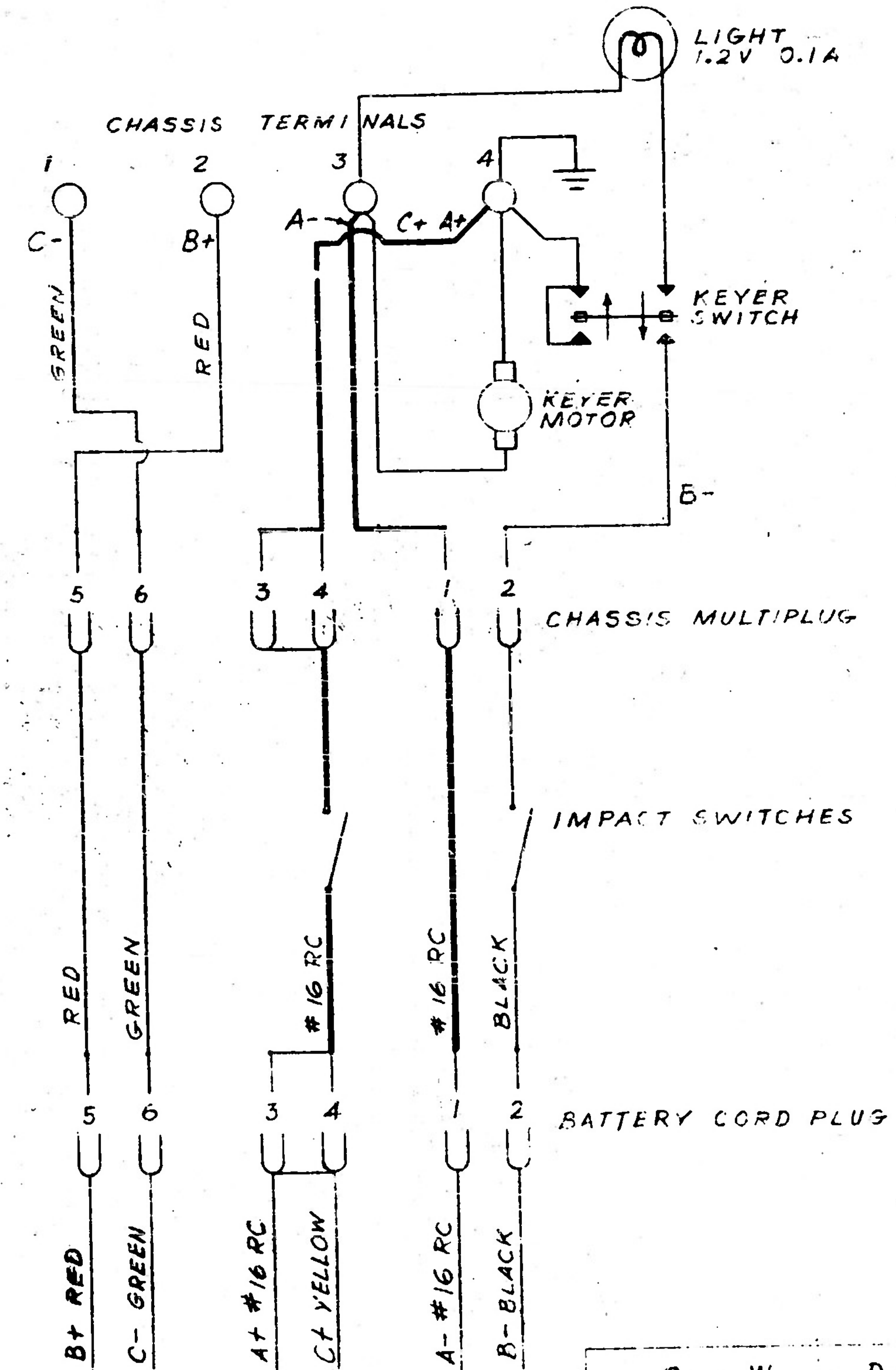
FLOAT COVER RETAINER

PROJECT W-121

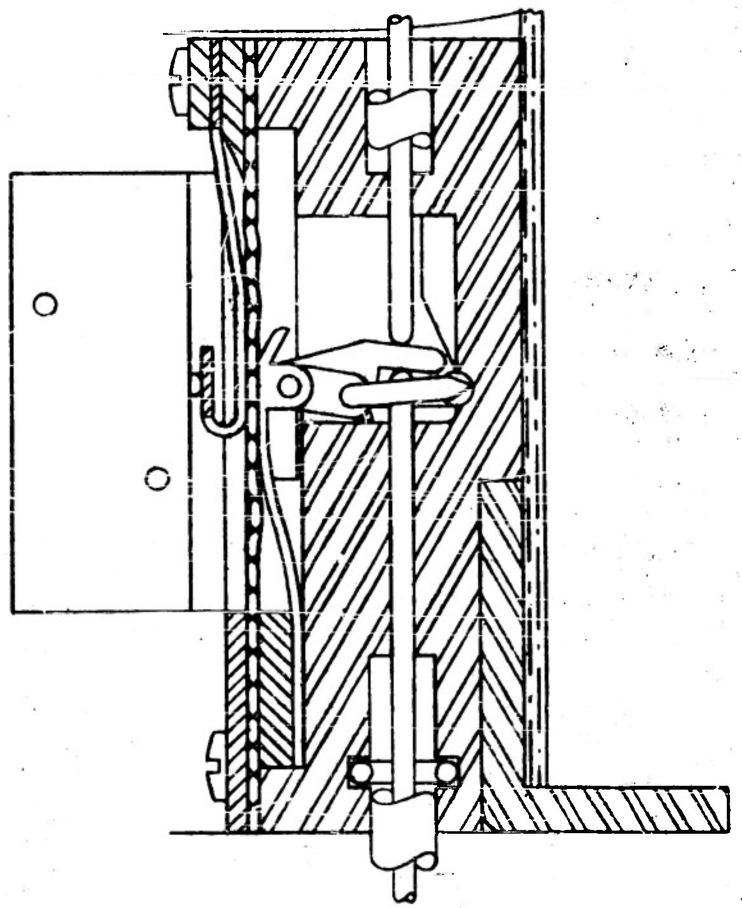
DRAWING Nº R-5

DATE 22-3-54 DRAWN BY J.F.


RIVET HOLES
A
B
C
D
TOP END PIECE 1 EA 1/16" AL
BOTTOM END PIECE 1 EA 1/16" AL
BACK LIKE B, END LIKE C, ABOVE
SIDE MEMBER
2 EA 1/32" AL
TRANSFORMER MOUNT
1 EA
KEYER MOUNT
2 EA
SIX PRONG MALE CONNECTOR
FITS BOT. END PIECE
CHASSIS PARTS - ANNEALED, FORMED, AND
HEAT TREATED TO T-6 TEMPER
61 S AL
TRANSMITTER CHASSIS
PROJECT W-121
DRAWING Nº T-1
DATE: 15-1-54
DRAWN BY: JF

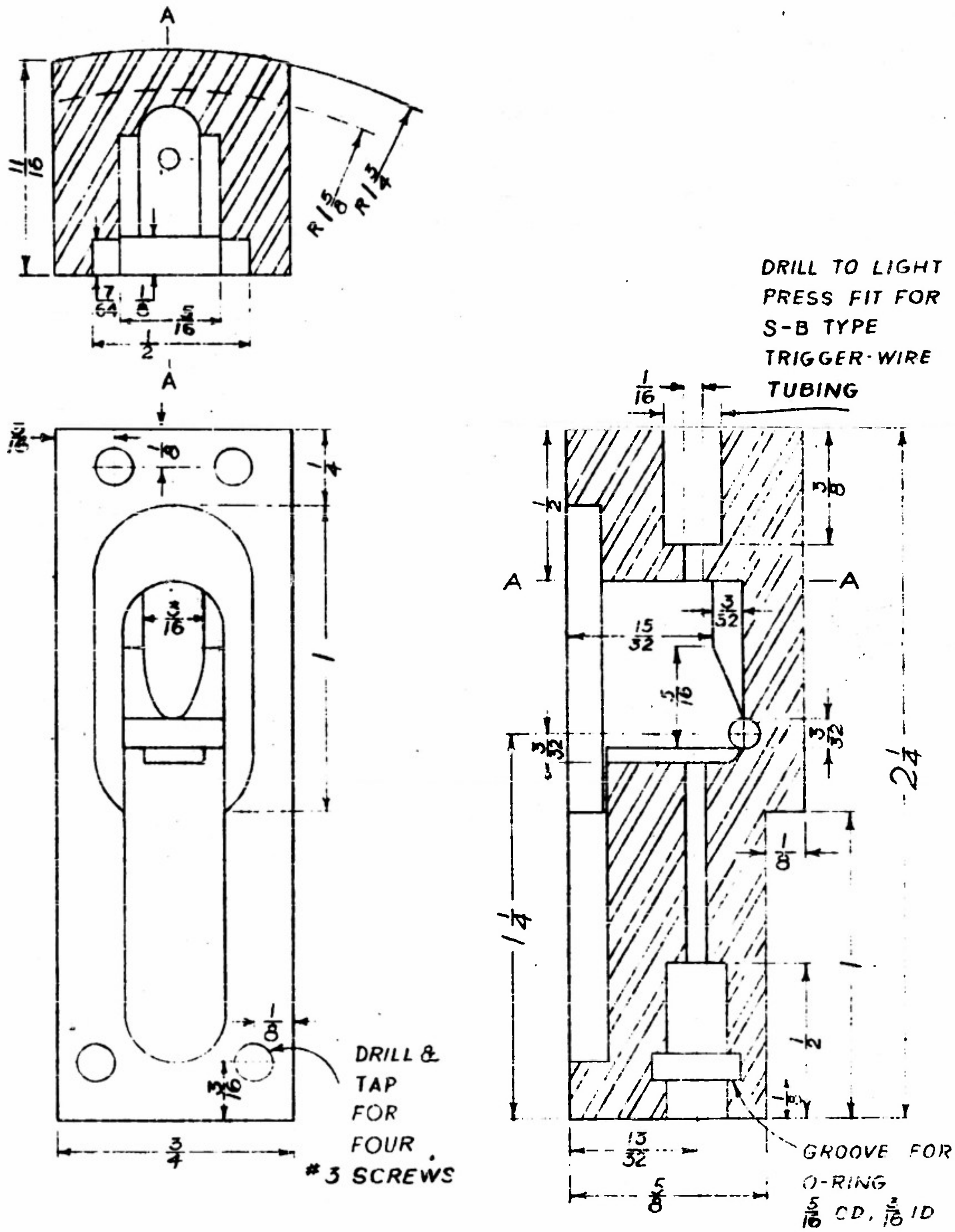


Case Wiring Diagram
Project W-121
Drawing No. T-2
Date: 2-3-54 Drawn By: JF



SCALE: 2-1

SWITCH ASSEMBLY
PROJECT W-121
DRAWING № T-3
DATE 5-11-53 DRAWN BY JF



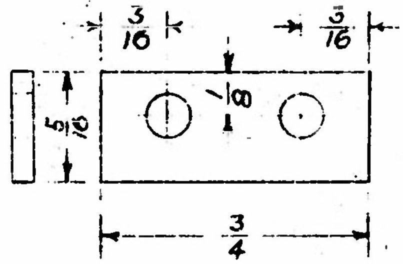
SCALE 2:1

LAYOUT SWITCH ACTUATOR BODY

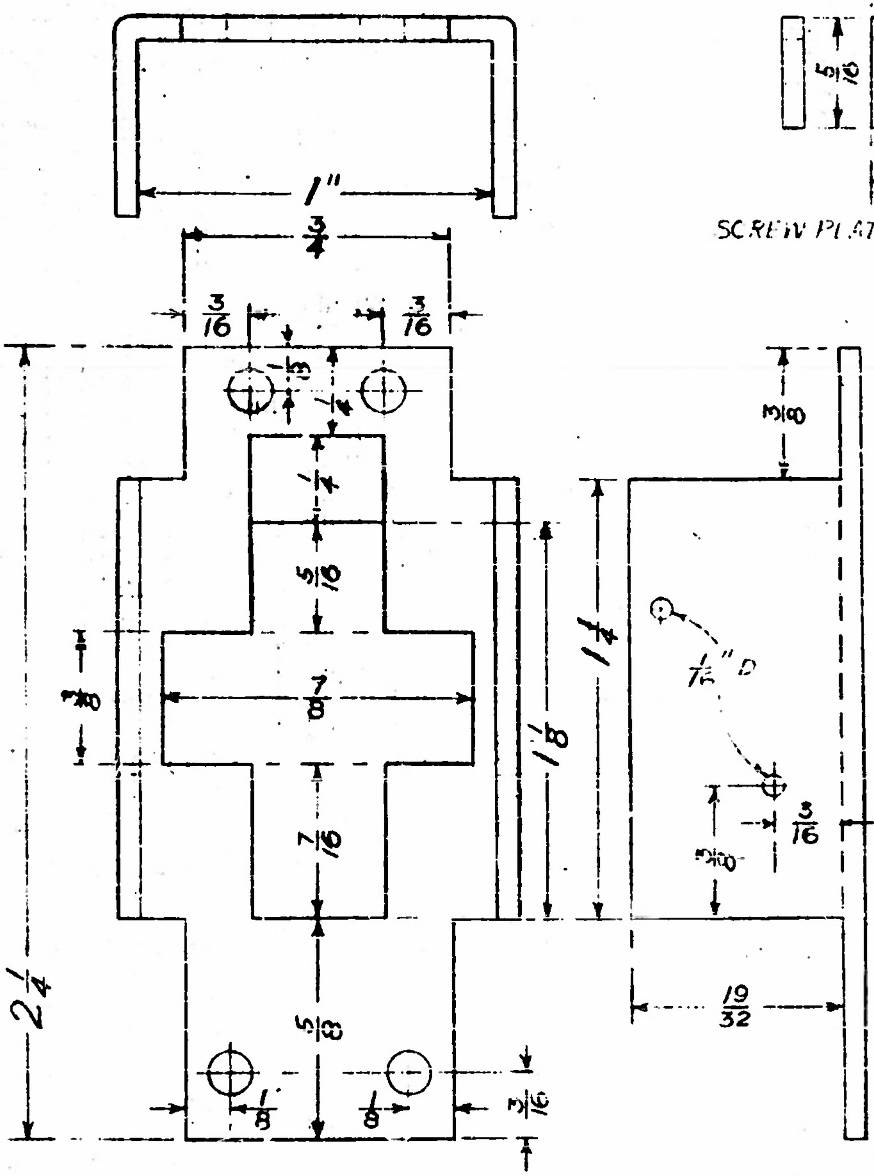
PROJECT W-121

DRAWING Nº T-4

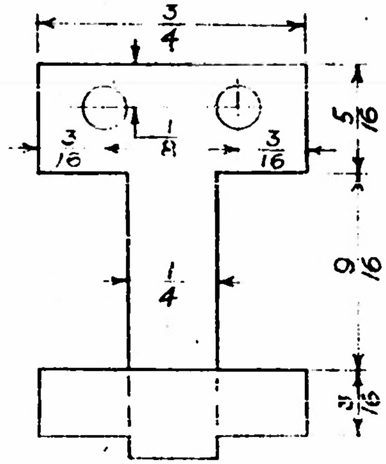
DATE 4-11-53 DRAWN BY JF



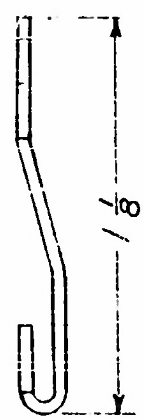
SCREW PLATE FOR AUXILIARY SPRING
-14 GAGE



COVER PLATE &
SWITCH BRACKET –
DRILL FOUR HOLES FOR #3 SCREWS
USE 14 GAGE ALUMINUM SHEET



AUXILIARY SPRING
-20 GAGE

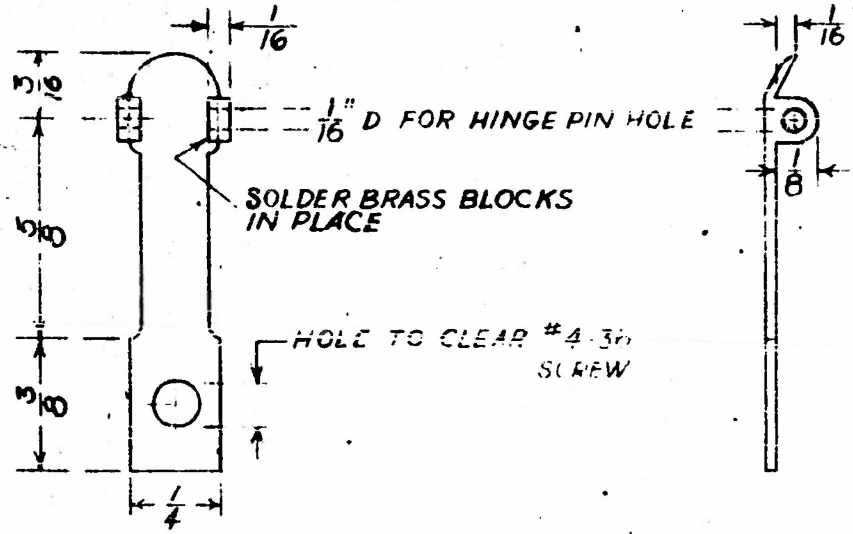


SCALE 2-1

COVER PLATE
PROJECT W-121
DRAWING No T-5
DATE: 17-6-53 DRAWN BY JF

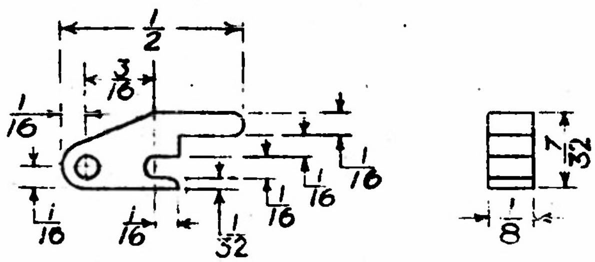
LATCH SPRING

PHOSPHOR BRONZE .031" THICK



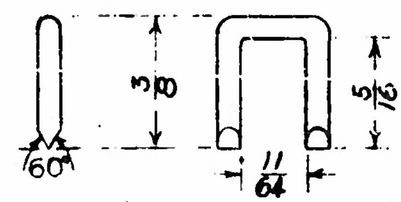
LATCH

STAINLESS STEEL 1/8" THICK



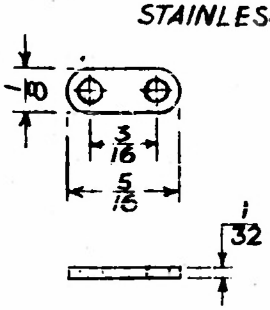
TOGGLE WIRE

STAINLESS STEEL 1/16" D



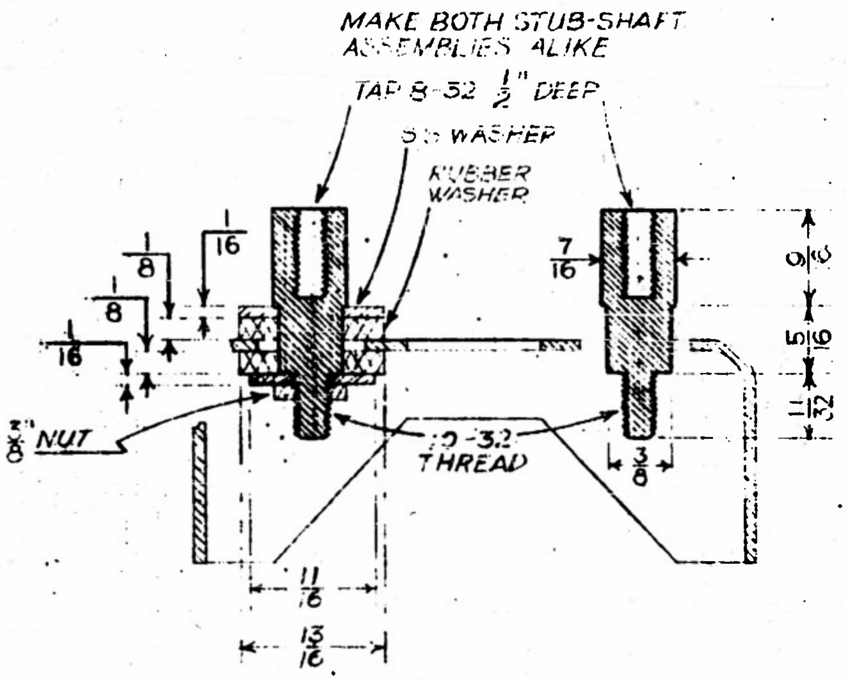
RETAINING PLATE

STAINLESS STEEL

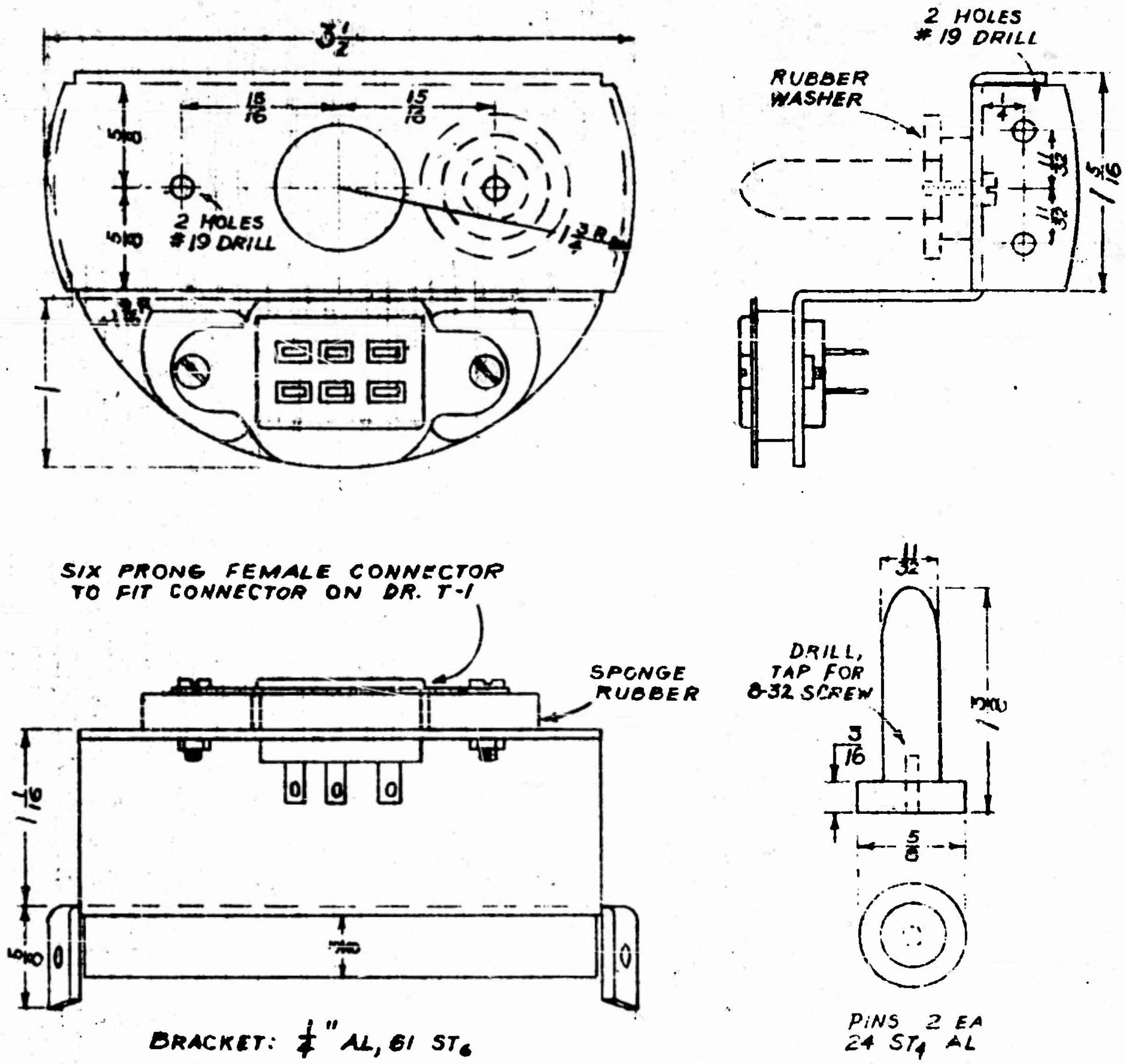


SCALE 2-1

TRANSMITTER & KEYER SWITCH	
PROJECT W-121	
DRAWING № T-6	
DATE 11-6-53	DRAWN BY JF



SHOCK MOUNT DETAIL
PROJECT W-121
DRAWING Nº 1-7
DATE 5-6-[illegible] DRAWN BY J.F



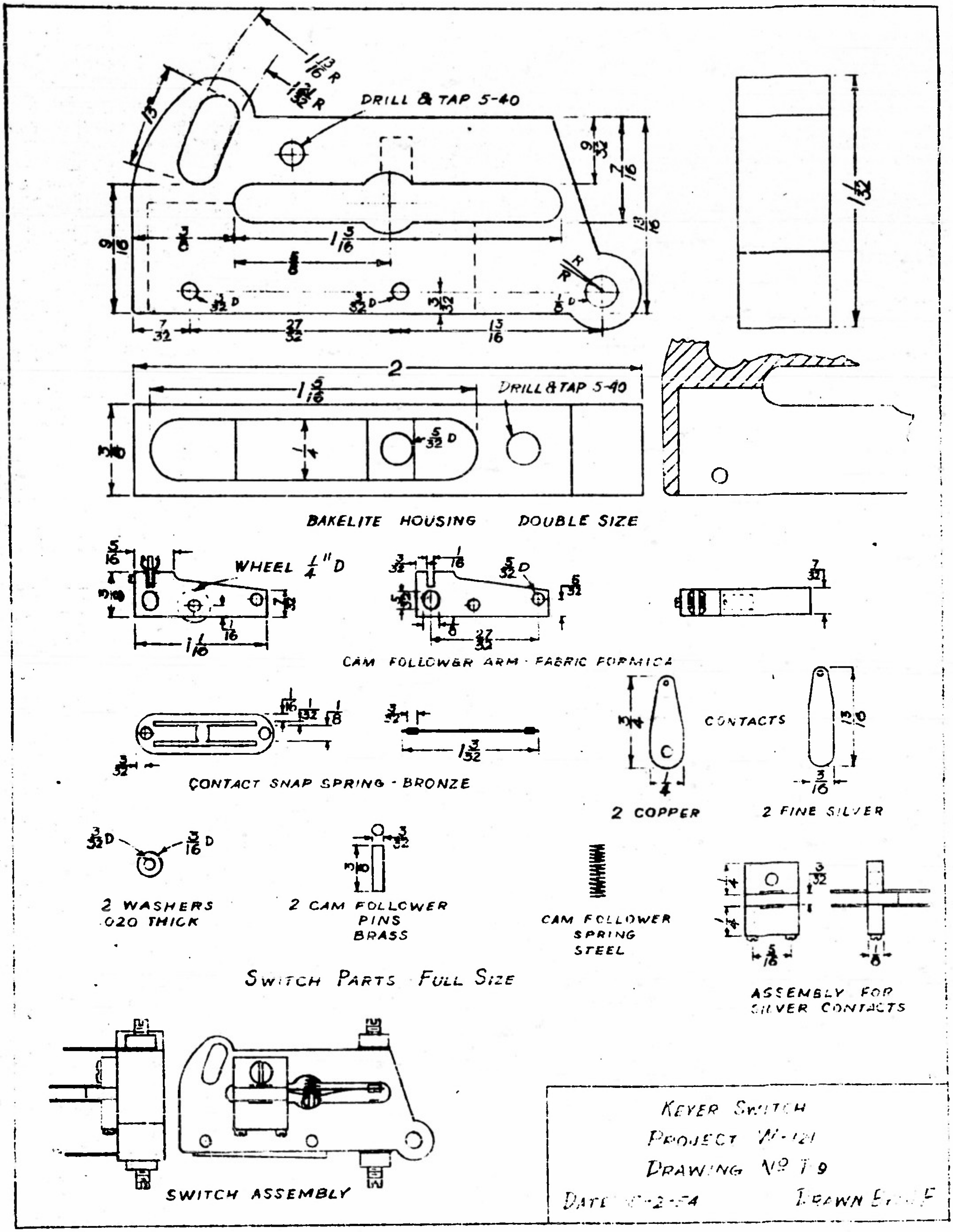
SCALE: FULL SIZE

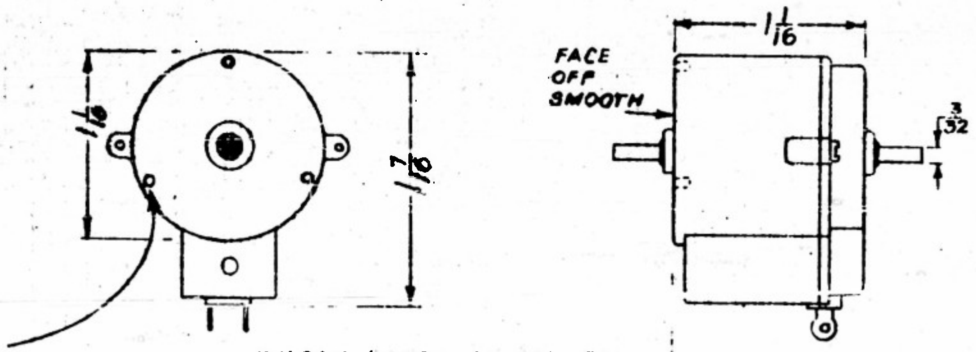
LOWER MOUNTING BRACKET

PROJECT W-121

DRAWING Nº T 8

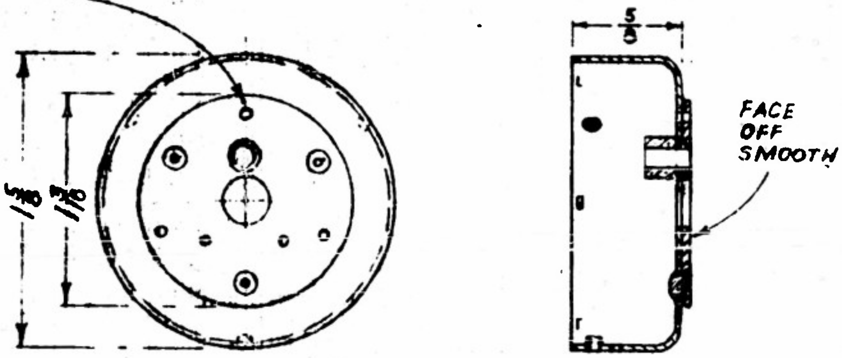
DATE: 19-1-54 DRAWN BY JF


DRILL & TAP 5-40
DRILL & TAP 5-40
BAKELITE HOUSING DOUBLE SIZE
WHEEL 1/4" D
CAM FOLLOWER ARM - FABRIC FORMICA
CONTACT SNAP SPRING - BRONZE
CONTACTS
2 COPPER
2 FINE SILVER
2 WASHERS .020 THICK
2 CAM FOLLOWER PINS BRASS
CAM FOLLOWER SPRING STEEL
ASSEMBLY FOR SILVER CONTACTS
SWITCH PARTS FULL SIZE
SWITCH ASSEMBLY
KEYER SWITCH
PROJECT
DRAWING No
DATE
DRAWN BY

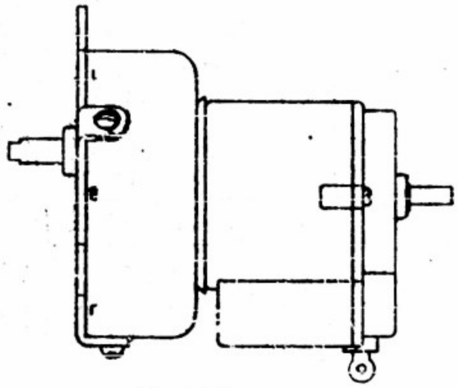


WILSON MOTOR Mod No 5002

#39 DRILL & TAP 3 CORRESPONDING HOLES IN MOTOR- AND GEAR-HOUSING



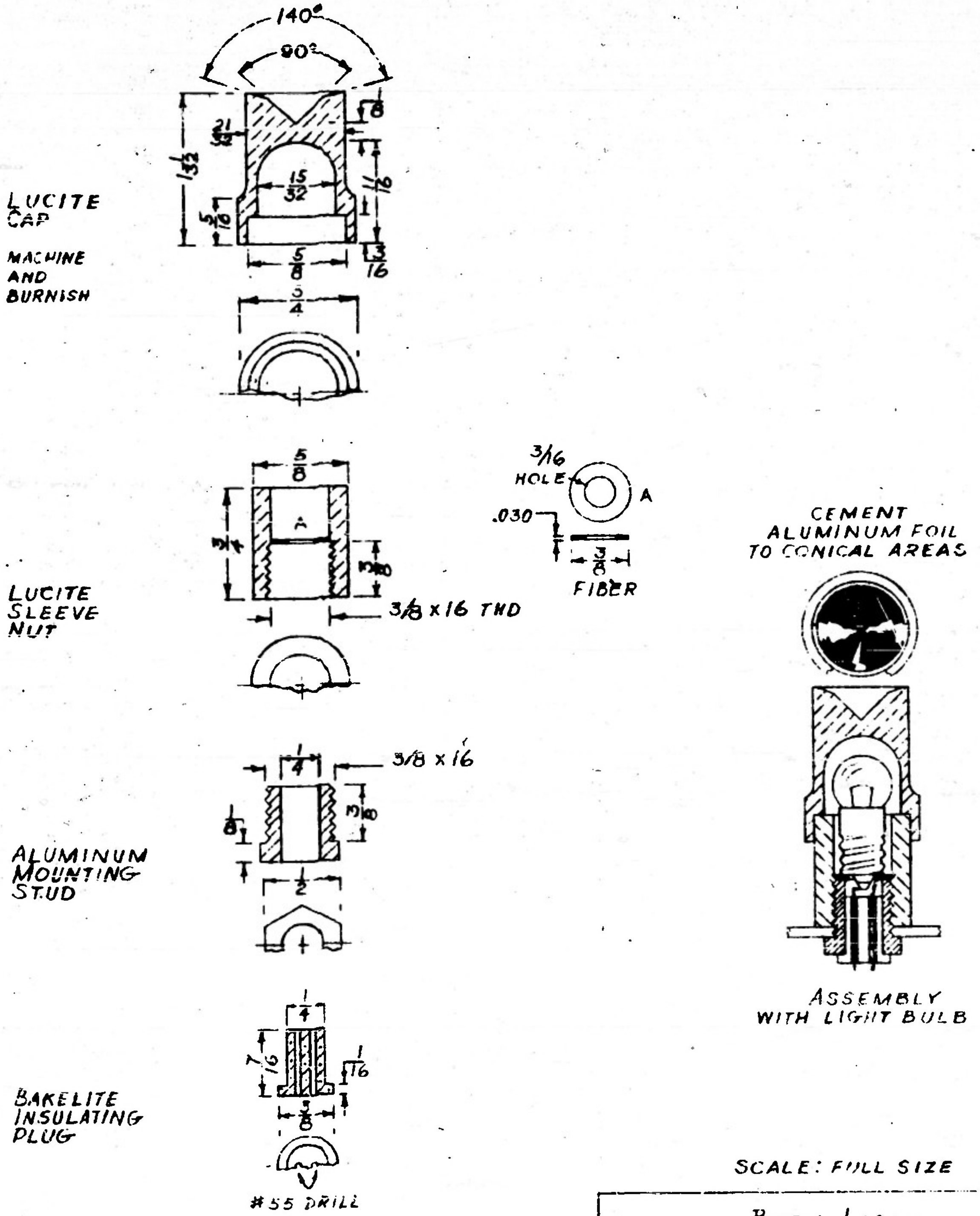
HANSEN GEAR UNIT Type D



ASSEMBLY

SCALE: FULL SIZE

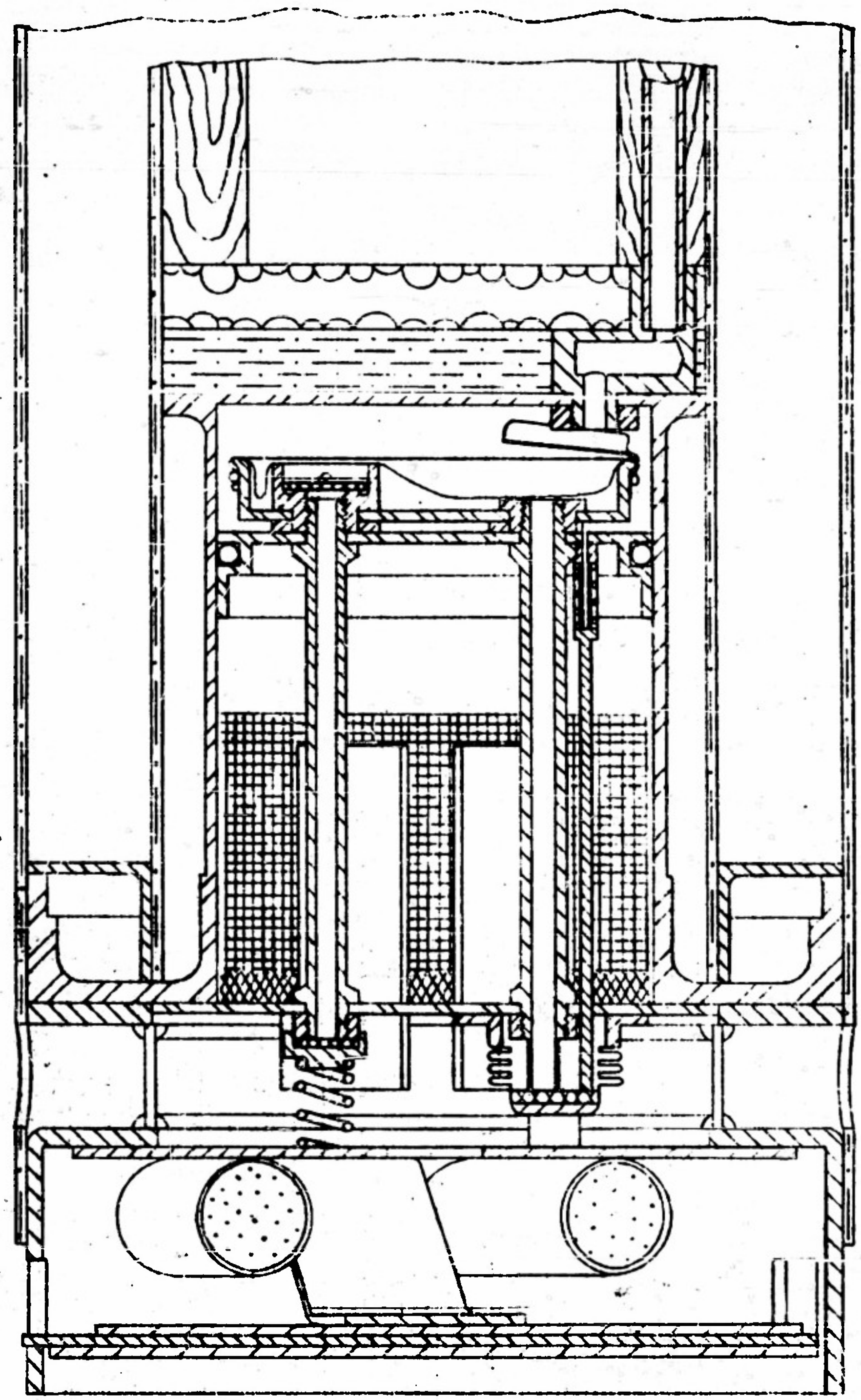
KEYER DRIVE
PROJECT W-121
DRAWING Nº T-10
DATE: 2-2-54 DRAWN BY: JF



SCALE: FULL SIZE

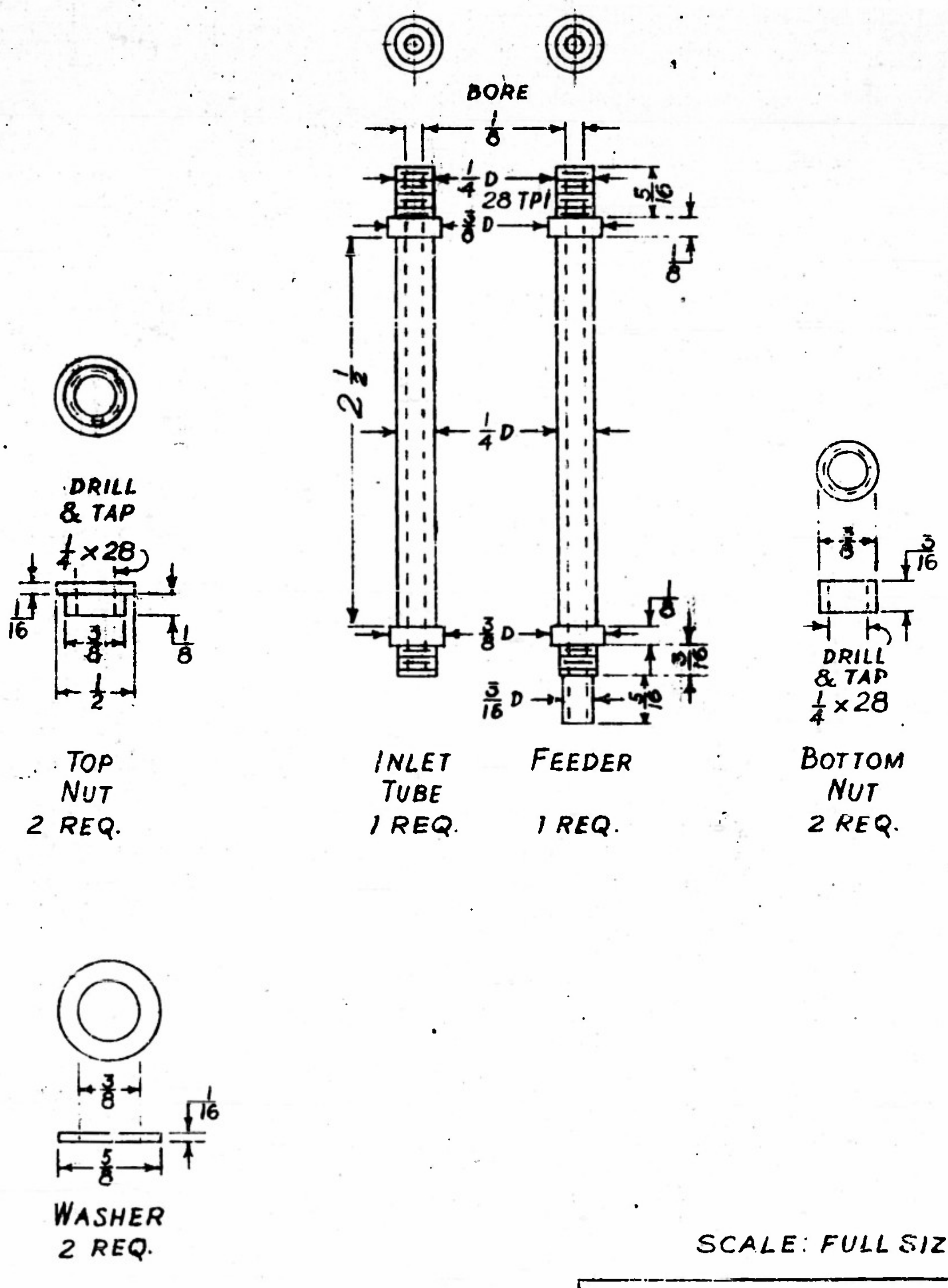
BUOY LIGHT
PROJECT W-121
DRAWING Nº T-11

DATE: 4-3-54 DRAWN BY: JF



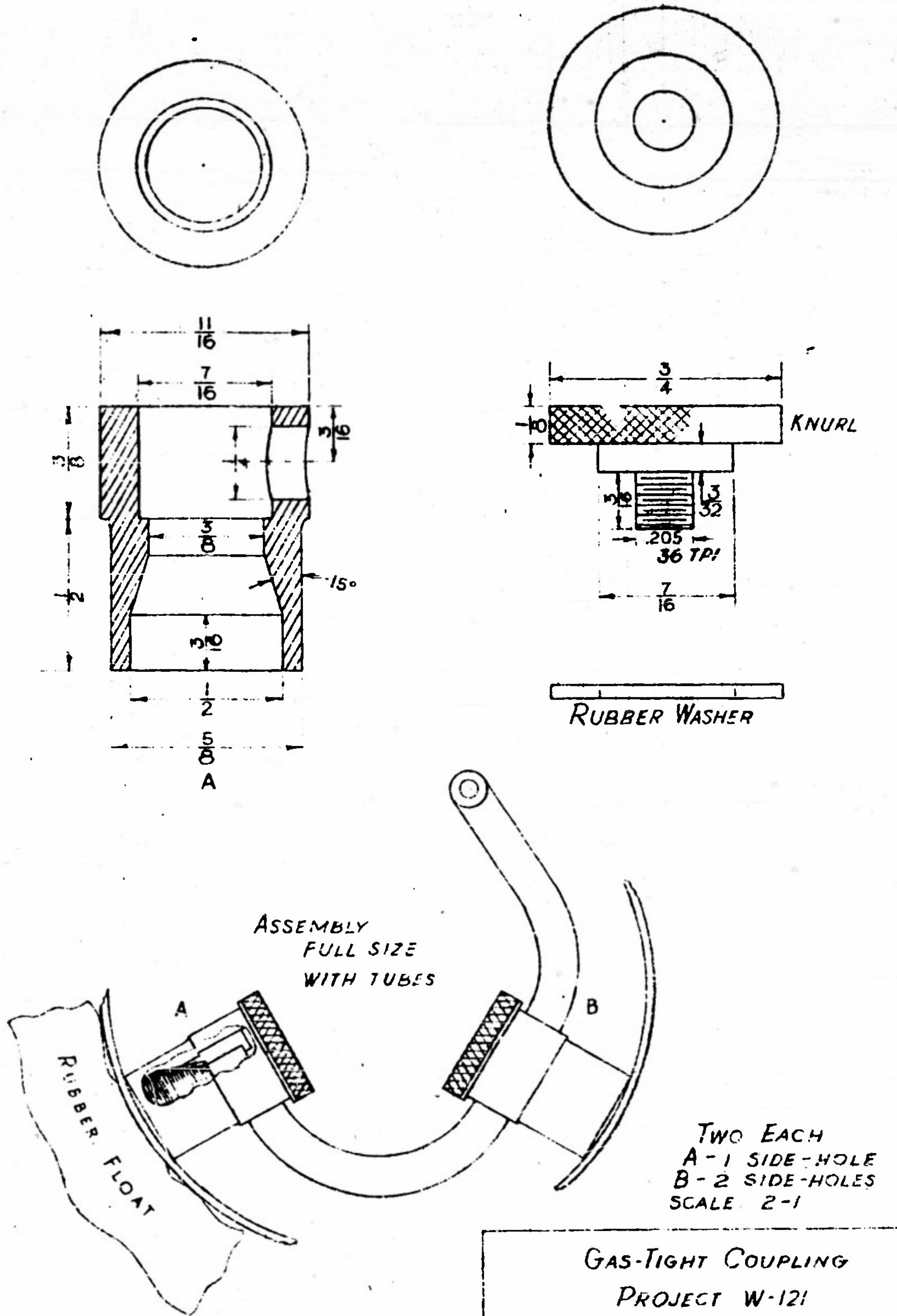
SCALE FULL SIZE

GAS GENERATOR ASSEMBLY
PROJECT W-121
DRAWING Nº G-1
DATE 9-2-54 DRAWN BY JF



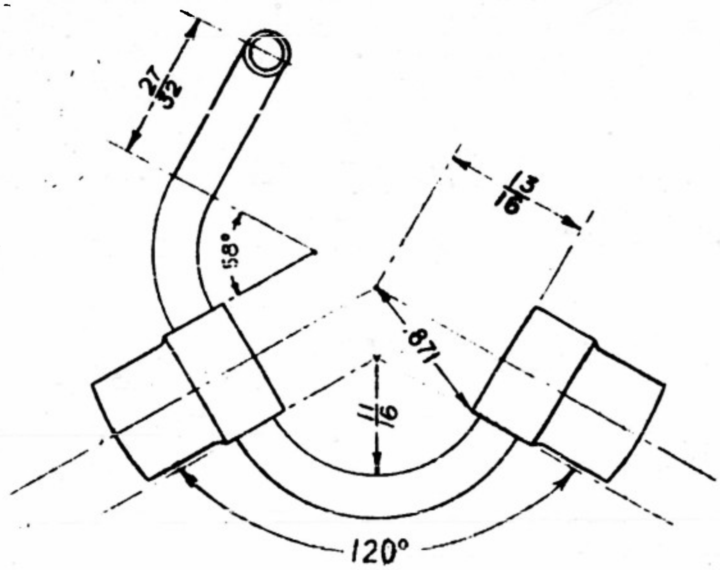
SCALE: FULL SIZE

GAS GENERATOR DETAILS
PROJECT W-121
DRAWING Nº G-2
DATE: 29-10-53 DRAWN BY: JF



TWO EACH
A - 1 SIDE-HOLE
B - 2 SIDE-HOLES
SCALE 2-1

GAS-TIGHT COUPLING
PROJECT W-121
DRAWING Nº G-3
DATE: 3-8-53 DRAWN BY J.F.



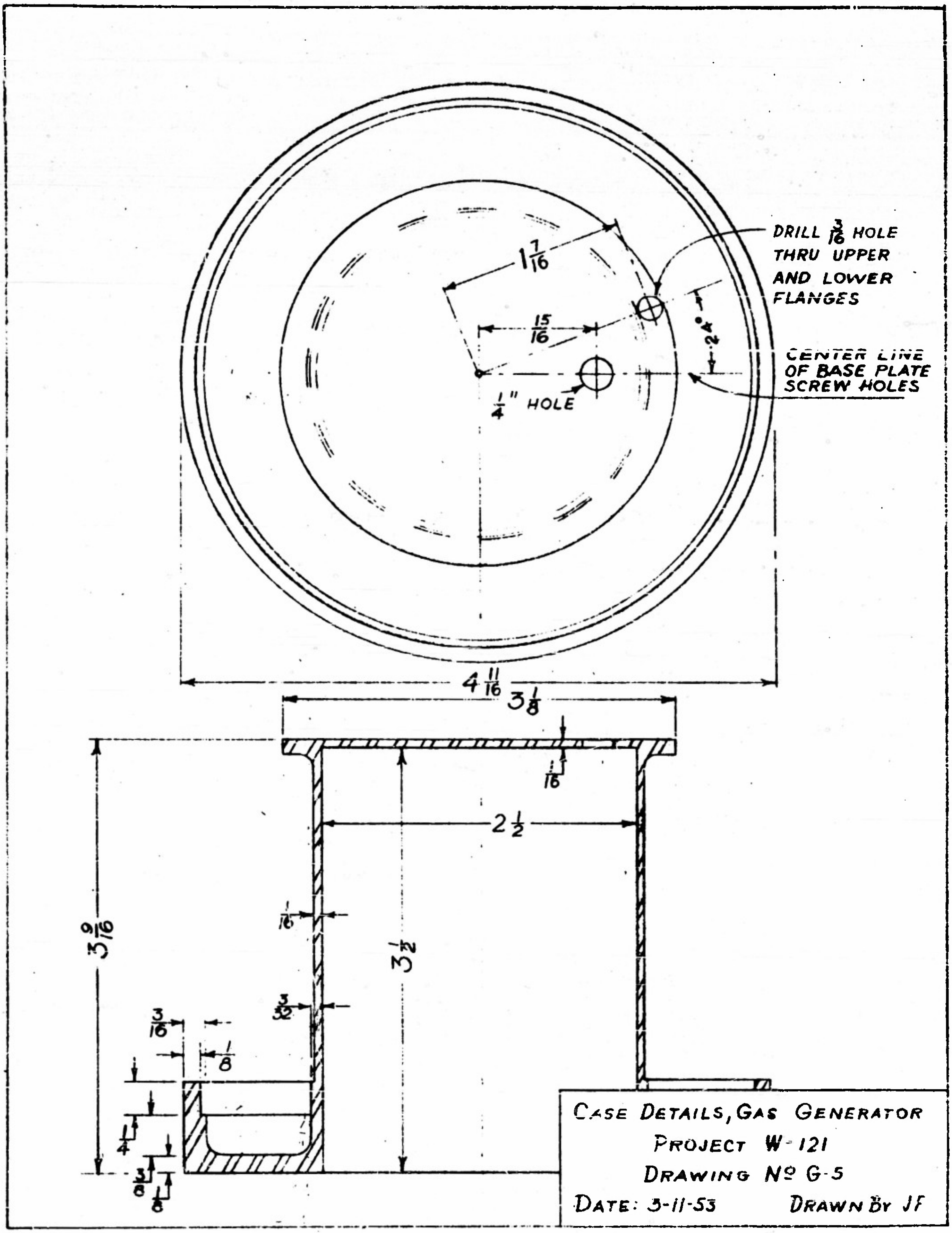
SCALE: FULL SIZE

GAS COUPLING LAYOUT

PROJECT W-121

DRAWING № G-4

DATE: 13-11-53 DRAWN BY: JF


DRILL 3/16 HOLE THRU UPPER AND LOWER FLANGES
1 7/16
15/16
24°
CENTER LINE OF BASE PLATE SCREW HOLES
1/4" HOLE
4 11/16
3 1/8
1/16
2 1/2
3 9/16
3 1/2
1/16
3/32
3/16
1/8
1/4
3/8
1/8
CASE DETAILS, GAS GENERATOR
PROJECT W-121
DRAWING Nº G-5
DATE: 3-11-53
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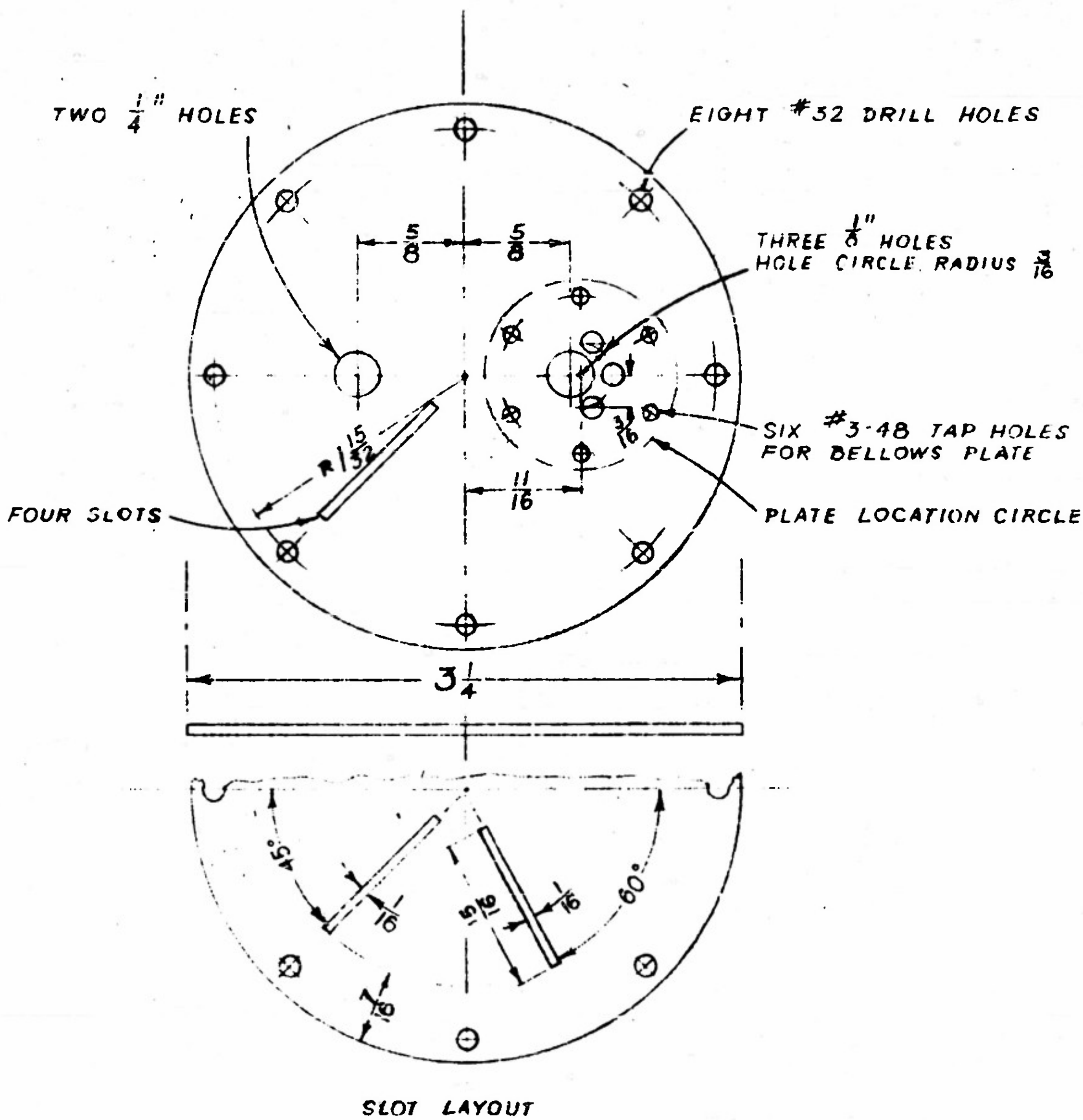
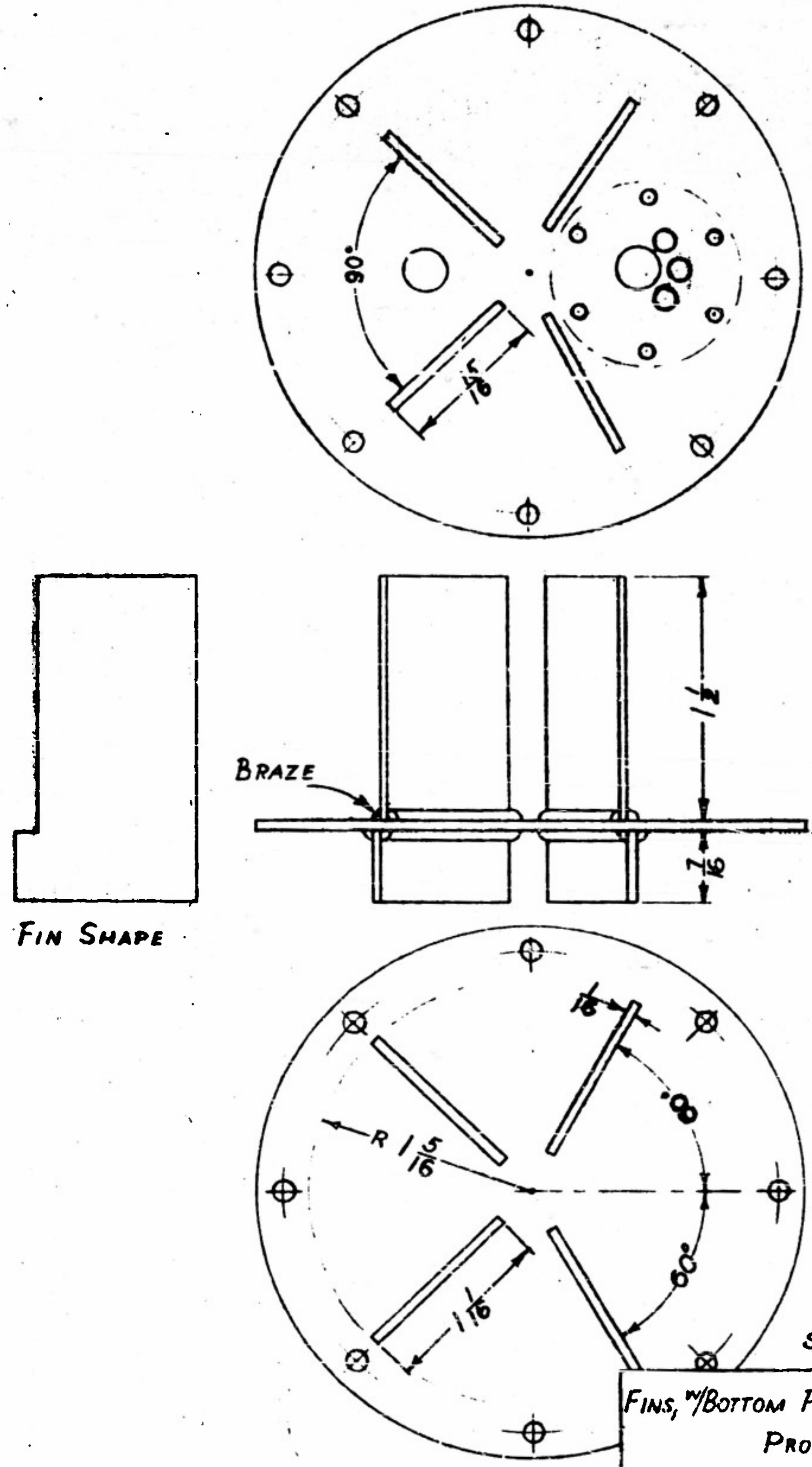


BOTTOM PLATE	(GAS GENERATOR)
PROJECT W-121	
DRAWING Nº G-6	
DATE: 17-11-53	DRAWN BY: JF



SCALE FULL SIZE

FINS, W/BOTTOM PLATE (GAS GENERATOR)

PROJECT W-121

DRAWING № G-7

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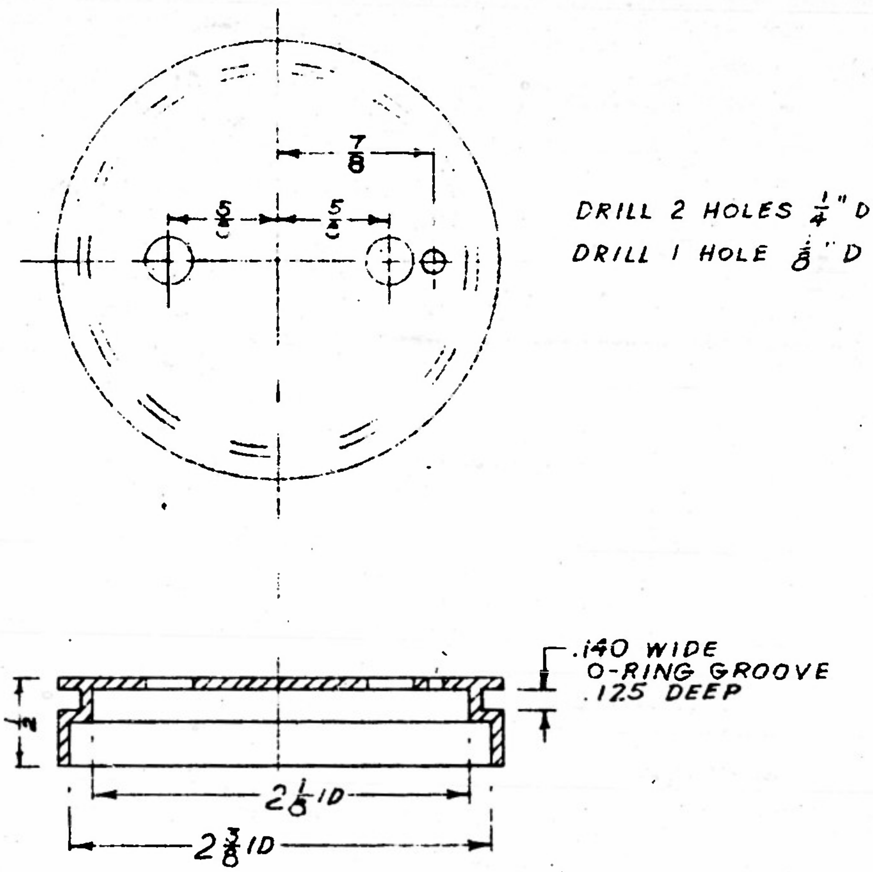

OD - SLIDING FIT IN GENERATOR

SCALE: FULL SIZE

PARTITION, GAS GENERATOR
PROJECT W-121
DRAWING № G-8
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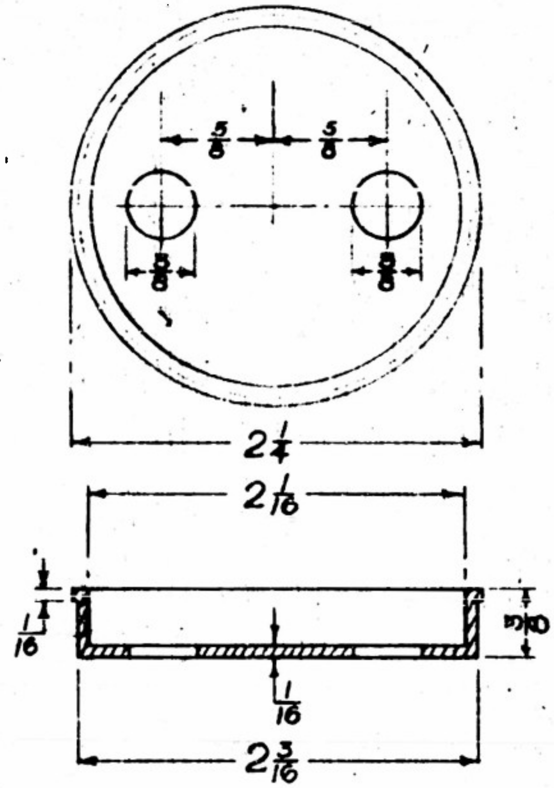

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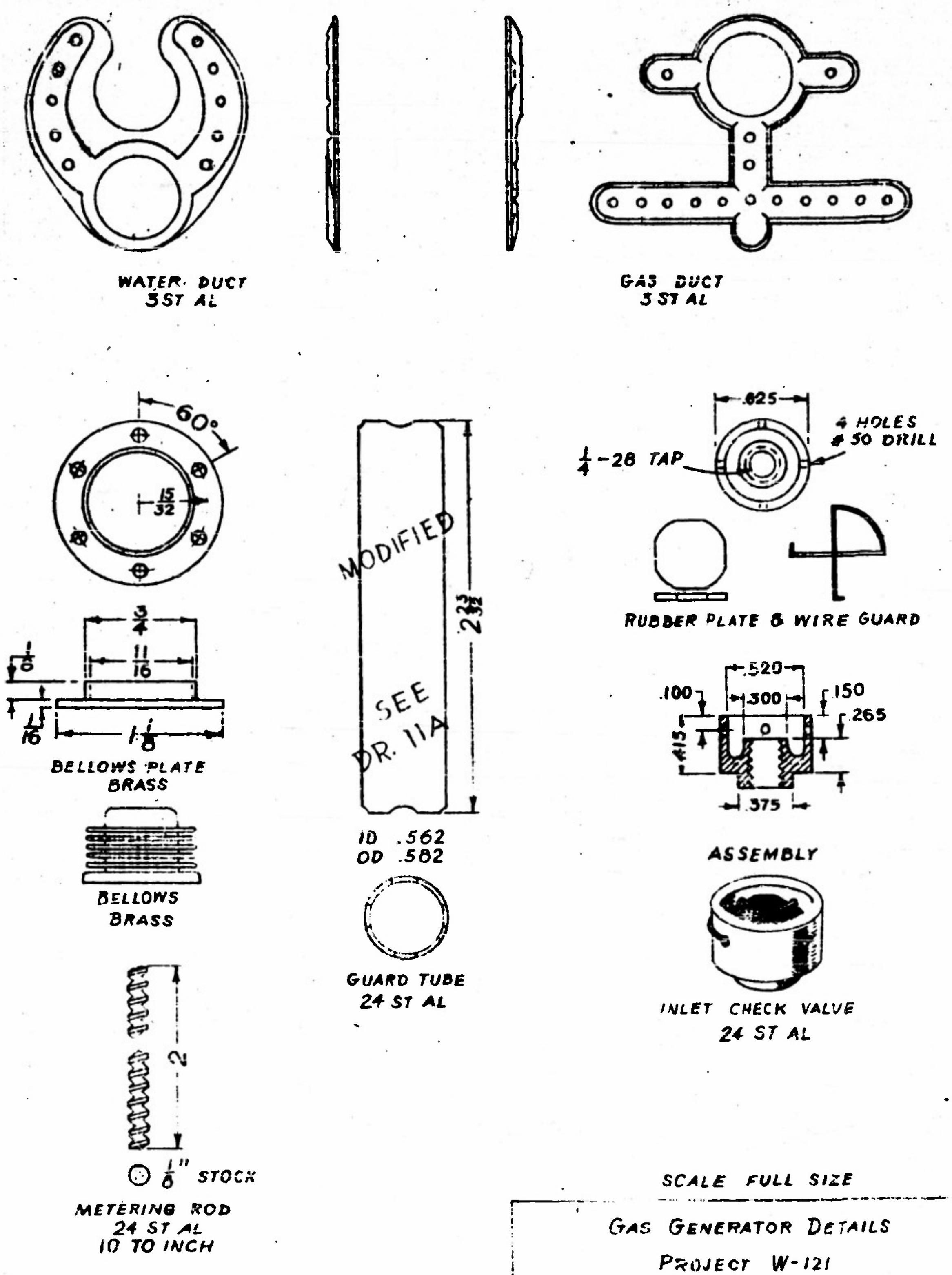
GAS GENERATOR RESERVOIR
PROJECT W-121
DRAWING Nº G-9
DATE: 2-11-53 DRAWN BY: JF



SCALE FULL SIZE

GAS GENERATOR DETAILS

PROJECT W-121

DRAWING Nº G-11

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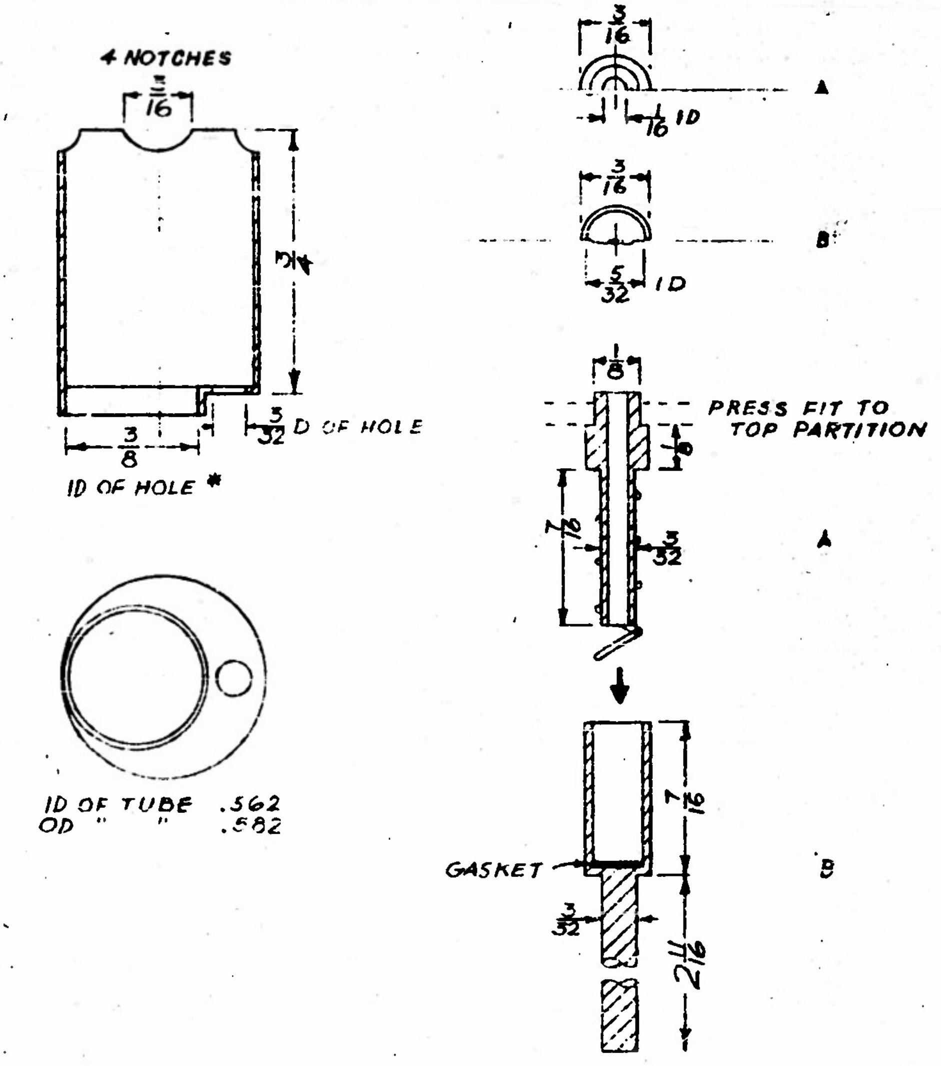
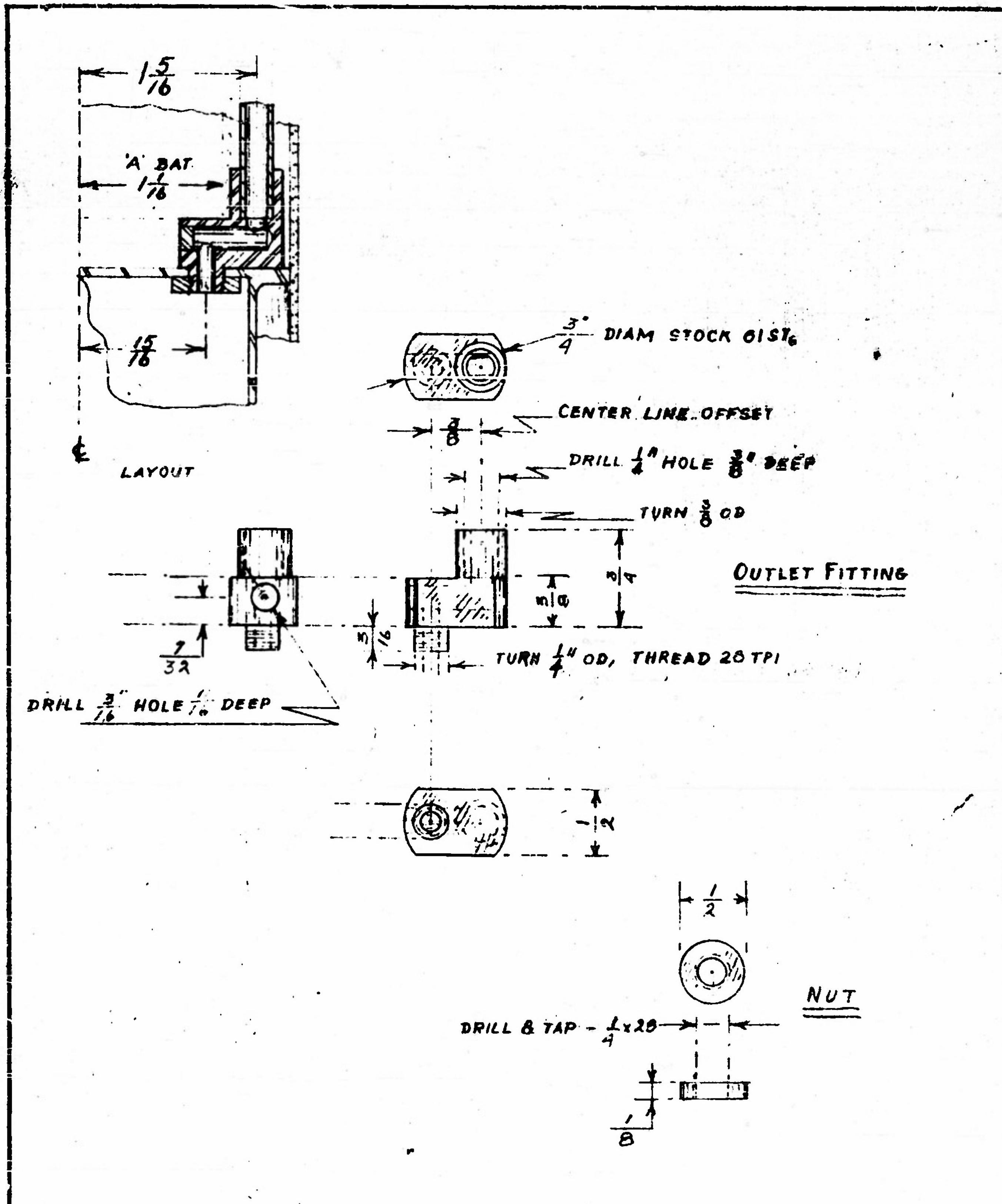


SCALE: 2-1

GAS GENERATOR DETAILS
PROJECT W-121
DRAWING Nº G-11A
DATE: 2-3-54 DRAWN BY: JF

* SPIN TO TIGHT FIT ON 1/4" SHAFT



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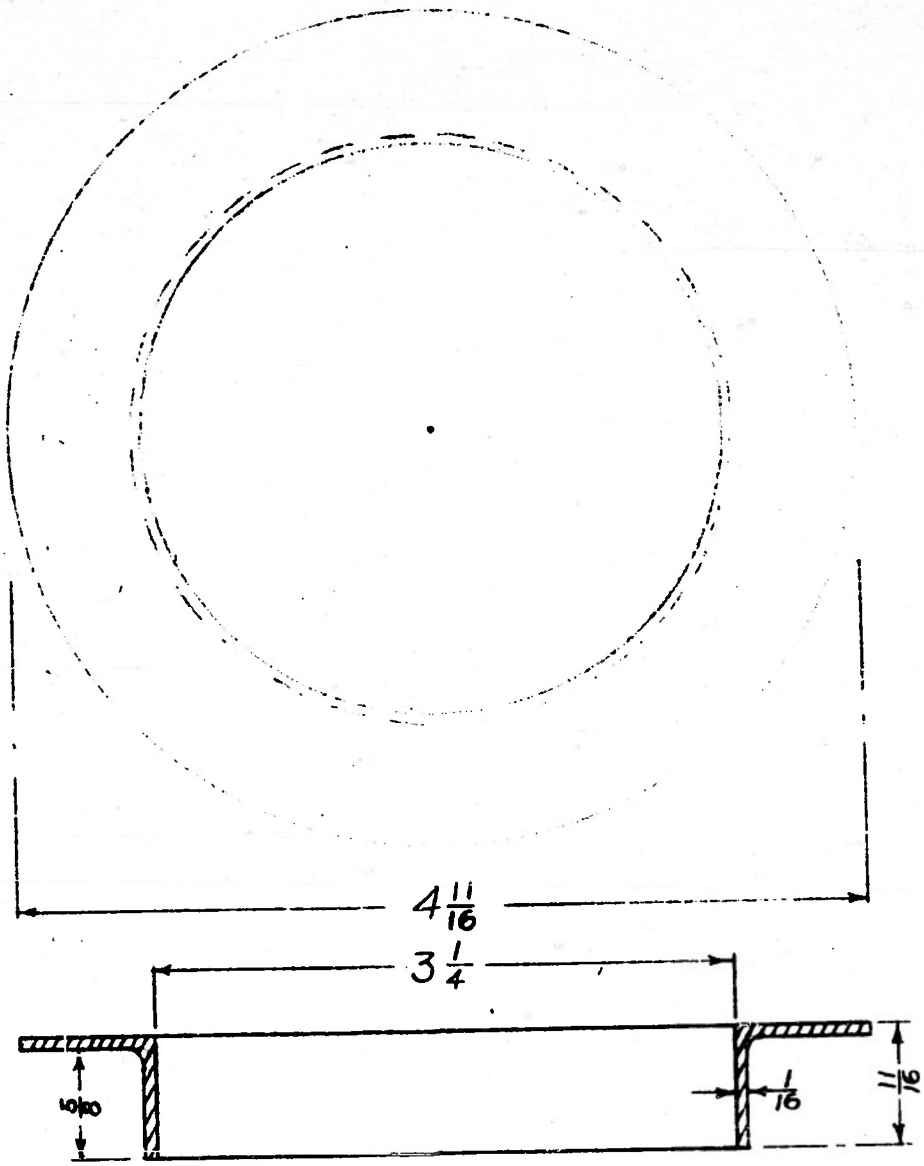
WOODS HOLE, MASS.

PROJ. W-121 BY HS

SHEET 9 OF 10 DATE 9-4-53

TITLE Gas Generator Outlet Fitting & Nut Drg No 6-12



SCALE FULL SIZE

BASE RING

PROJECT W-121

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